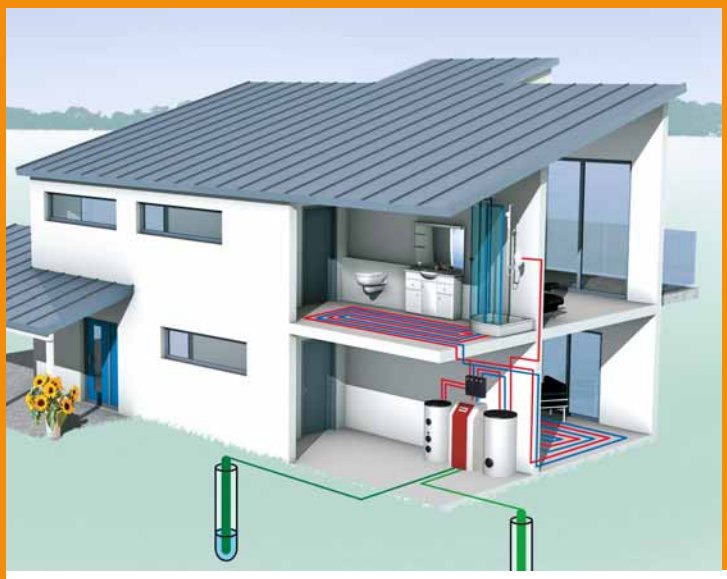

PROJECT PLANNING AND INSTALLATION MANUAL

HEAT PUMPS FOR HEATING AND HOT WATER PREPARATION

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What are the Benefits of a Heat Pump?

The fact that a large percentage of our energy supply is produced from fossil fuels poses serious consequences for our environment. Large quantities of pollutants such as sulphur and nitrogen oxide are released during combustion.

Domestic space heating with fossil fuels contributes significantly to pollutant emissions because extensive emission control measures, such as those used in modern power plants, cannot be carried out. Since our oil and gas reserves are limited, basing such a large percentage of our energy supply on fossil fuel sources also presents a serious problem.

The way electrical energy is generated will change in the future to favour more renewable or newly developed generation methods. You, too, can be a part of this development because electricity as the energy of the future is the operating energy of heat pumps.

What does a heat pump do?

A heat pump is a type of “transport device” that raises the temperature level of the heat that is freely available in the environment.

How does a heat pump convert low temperature heat into higher temperature heat?

It extracts stored solar heat from the environment – ground, water (e.g. ground water) and air (e.g. outside air) – and transfers this, along with the operating energy, in the form of heat to the heating and hot water system.

Heat cannot transfer from a cold body to a warm body on its own. Rather, it flows from a body with a higher temperature to a body with a lower temperature (Second Law of Thermodynamics). For this reason, the heat pump must raise the temperature of the thermal energy extracted from the environment using high-grade energy - e.g. electricity for the drive motor - to a level suitable for heating and domestic hot water preparation.

Heat pumps work like a refrigerator – in other words, the same technology is applied but the function is reversed. It extracts heat from a cold environment which can then be used for heating and domestic hot water preparation.

Glossary

Defrosting

Regular routine for removing frost and ice from evaporators on air-to-water heat pumps by applying heat. Air-to-water heat pumps with reversal of the direction of circulation feature the rapid and energy efficient defrosting properties required.

Bivalent-parallel operation

The bivalent operating mode (today this is normally bivalent-parallel operation) functions with two heat generators (two sources of energy), i.e. the heat pump covers the heating requirements up to a determined temperature limit (as a rule -5 °C) and is then backed up by a second energy source in parallel.

Bivalent-renewable operating mode

The bivalent-renewable operating mode makes it possible to incorporate renewable heat sources such as wood or thermal solar energy. Should renewable energy sources be available, then heat pump is blocked and the current heating, hot water or swimming pool needs are met by the renewable cylinder.

Carnot factor

The ideal reference cycle for all thermodynamic cycles is the so-called Carnot cycle. This (theoretical) model cycle gives maximum efficiency and - in comparison to a heat pump - the theoretically greatest possible COP. The Carnot factor is based solely on the temperature difference between the warm side and the cold side.

D-A-CH seal of approval

Certificate for heat pumps in Germany, Austria and Switzerland which fulfil specific technical requirements, have a 2-year warranty, ensure the availability of spare parts for up to 10 years and whose manufacturers offer a comprehensive customer service network. The seal of approval also certifies that a line of heat pumps has been manufactured as a series.

Utility company shut-off times

Local utility companies offer special tariffs for heat pumps providing the power supply can be shut off by the utility company at certain times of day. The power supply can, for example, be interrupted for 3 X 2 hours within a 24-hour period. This means that the daily heat output (quantity of heat produced daily) must be produced within the period of time in which electrical energy is available.

Expansion valve

Heat pump component between the liquefier and the evaporator for reducing the condensation pressure to coincide with the respective evaporation pressure determined by the evaporation temperature. The expansion valve also controls the quantity of refrigerant to be injected in relation to the respective evaporator load.

Limit temperature / bivalence point

The outside temperature at which the 2nd heat generator is additionally connected in mono energy (electric heating element) and bivalent-parallel operation (e.g. boiler), and both modes of operation jointly provide the house with heat.

Annual performance factor

The annual performance factor is defined as the ratio of the quantity of electrical energy supplied in one year to the amount of thermal energy extracted by the heat pump system. It is based on a particular heating system taking the respective design of that system into consideration (temperature level and temperature difference) and is not the same as the coefficient of performance.

Annual effort figure

The annual effort figure is exactly the opposite of the performance factor. The annual effort figure indicates what input (e.g. electrical energy) is required to achieve a defined benefit (e.g. heating energy). The annual effort figure also includes the energy for the auxiliary drives. The VDI Guideline VDI 4650 is used to calculate the annual effort figure.

Cooling capacity

Heat flow which is extracted from the surroundings by the evaporator of a heat pump. The heat output of the compressor is calculated from the electrical power consumption and refrigerating capacity applied.

Refrigerant

The working medium used in a refrigerating machine or heat pump is called a refrigerant. It can be characterized as a fluid which is used for transferring heat in a refrigerating system. Refrigerants absorb heat at a low temperature and pressure and emit heat at a higher temperature and pressure. Refrigerants which are non-poisonous and non-inflammable are designated as safety refrigerants.

COP, coefficient of performance

The ratio between the absorbed electrical energy and the heat output emitted by the heat pump is expressed by the coefficient of performance (COP). This is measured under standardized boundary conditions in a laboratory according to EN 255 (e.g. for air A2/W35, A2= air intake temperature +2 °C, W35= heating water flow temperature 35 °C). A COP of 3.2, for example, means that 3.2 times the consumed electrical energy is available as usable heat output.

lg p,h diagram

Graphic representation of the thermodynamic properties of a working medium (enthalpy, pressure, temperature).

Mono energy operation

In principle, the mono energy mode of operation is a bivalent-parallel mode of operation utilizing only one source of energy, normally electricity. The heat pump supplies a large part of the required heat output. An electric heating element supplements the heat pump on those few days during the year with extremely low external temperatures.

Air-to-water heat pumps are normally dimensioned for a limit temperature (also known as the bivalence point) of approx. -5 °C.

Monovalent operation

In this operating mode, the annual heat consumption of the building is completely covered (100%). This type of application should be preferred wherever possible.

Brine-to-water and water-to-water heat pumps are normally operated in monovalent mode.

Buffer tank

The installation of a heating water buffer tank is basically recommended to lengthen the runtimes of the heat pump during periods of reduced heating demand.

A buffer tank is absolutely essential for air-to-water heat pumps to guarantee a minimum runtime of 10 minutes during defrosting (regular routine for removing frost and ice from the evaporator).

Sound

A distinction is made between two types of sound, airborne sound and solid-borne sound. Airborne sound is sound which spreads through the air. Solid-borne sound spreads through solid materials or fluids and is also partially emitted as airborne sound. The audible sound range is between 16 and 16,000 Hz.

Sound pressure level

The sound pressure level measured in the surroundings is not a machine-specific quantity, but a quantity dependent on the test distance and the test location.

Sound power level

The sound power level is a machine-specific and comparable parameter for the acoustic output emitted by a heat pump. Both the sound emission level to be expected at particular distances and the acoustic environment can be estimated. The standard treats the sound power level as a characteristic noise value.

Brine / brine fluid

Frost-proof mixture consisting of water and a glycol-based anti-freeze concentrate for use in ground heat collectors and borehole heat exchangers.

Evaporator

Heat exchanger of a heat pump in which a heat flow is extracted by evaporation of a working medium of the heat source (air, ground water, ground) at a low temperature and with a low pressure.

Compressor

Machine for the mechanical conveyance and compression of gases. The pressure and temperature of the refrigerant are raised considerably by means of compression.

Liquefier

Heat exchanger of a heat pump in which the heat flow is emitted by liquifaction of a working medium.

Heat consumption calculation

Accurate dimensioning is essential for heat pump systems because overdimensioned systems increase energy costs and have a negative effect on efficiency.

The heat consumption is calculated on the basis of national standards.

The specific heat consumption (W/m^2) is multiplied by the living space area to be heated. The result is the total heat consumption including both the transmission heat consumption as well as the ventilation heat consumption.

Heating system

The heating system (radiators and circulation pump) has a large influence on the efficiency of the heat pump heating system, and should function with the lowest possible flow temperatures. It consists of the system used for conveying the heat transfer medium from the warm side of the heat pump to the heat consumers. For example, in a detached house the heating system consists of the piping for heat distribution, the underfloor heating system and/or the radiators and includes all auxiliary equipment as well.

Heat pump system

A heat pump system consists of the heat pump and the heat source system. Heat source systems for brine-to-water and water-to-water heat pumps must be separately tapped.

Heat pump heating system

Complete system consisting of the heat source system, the heat pump and the heating system.

Heat source

Medium from which heat is extracted with the heat pump.

Heat source system

System for the extraction of heat from a heat source and the conveyance of the heat transfer medium between the heat source and the heat pump including all auxiliary equipment.

Heat transfer medium

Liquid or gaseous medium (e.g. water, brine or air) with which heat is conveyed.

Panel heating

Panel heating has water flowing through it and functions like a large radiator. It has the same advantages as underfloor heating. As a rule, a temperature of 25 °C to 28 °C is sufficient for the heat transfer which is mainly supplied to the rooms in the form of radiant heat.

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DIN Deutsches Institut für Normung e.V., Beuth Verlag GmbH, Berlin.

VDI-Richtlinien – Gesellschaft technische Gebäudeausrüstung, Beuth Verlag GmbH, Berlin.

Symbols

Size	Symbol	Unit	Additional units (definition)
Mass	M	kg	
Density	ρ	kg/m^3	
Time	t	s h	1 h = 3,600 s
Volume flow	$\dot{V}$	m^3/s	
Mass flow	$\dot{M}$	kg/s	
Force	F	N	1 N = 1 kg m/s^2
Pressure	p	N/m^2; Pa	1 Pa = 1 N/m^2 1 bar = 10^5 Pa
Energy, work, heat (quantity)	E, Q	A kWh	1 J = 1 Nm = 1 Ws = 1 kg m^2/s^2 1 kWh = 3600 kJ = 3.6 MJ
Enthalpy	H	A	
(Heat) output **Heat flow**	P, $\dot{Q}$	W kW	1 W = 1 J/s = 1 Nm/s
Temperature	T	K °C	Absolute temperature, temperature difference Temperature in °Celsius
Sound power **Sound pressure**	L_{WA} L_{PA}	dB(re 1pW) dB(re 20μPa)	Sound pressure level, sound power level
Efficiency	η	-	
COP, coefficient of performance	ε (COP)	-	Output figures
Performance factor	ß		For example, annual performance factor
Specific heat content	c	J/(kg K)	

Greek alphabet

α	A	alpha	ι	I	iota	ρ	P	rho
β	B	beta	κ	K	kappa	σ	Σ	sigma
γ	Γ	gamma	λ	X	lambda	τ	T	tau
δ	Δ	delta	μ	M	mu	υ	Y	ypsilon
ε	E	epsilon	ν	N	nu	φ	A	phi
ζ	Z	zeta	ξ	Ξ	xi	χ	X	chi
η	H	eta	ο	E	omicron	ψ	Ψ	psi
A	θ	theta	π	Π	pi	ω	Ω	omega

Energy Content of Various Types of Fuel

Fuel	Heating value[1] H_i (H_u)	Calorific value[2] H_s (H_o)	max. CO_2 emission (kg/kWh) based on	
			Heating value	Calorific value
Coal	8.14 kWh/kg	8.41 kWh/kg	0.350	0.339
Heating oil EL	10.08 kWh/kg	10.57 kWh/kg	0.312	0.298
Heating oil S	10.61 kWh/kg	11.27 kWh/kg	0.290	0.273
Natural gas L	8.87 kWh/m_n^3	9.76 kWh/m_n^3	0.200	0.182
Natural gas H	10.42 kWh/m_n^3	11.42 kWh/m_n^3	0.200	0.182
Liquefied gas (propane) (ρ = 0.51 kg/l)	12.90 kWh/kg 6.58 kWh/kg	14.00 kWh/kg 7.14 kWh/kg	0.240	0.220

1. Heating value Hi (formerly H_u)
   The heating value H_i (also called the lower heating value) is the thermal energy which is released during total combustion when the steam produced during combustion is discharged without being utilized.
2. Calorific value Hs (formerly H_o)
   The calorific value H_s (also called the upper heating value) is the thermal energy which is released during total combustion when the steam produced during combustion is condensated so that the heat of evaporation is therefore available for use.

Conversion Tables

Energy units

Unit	A	kWh	kcal
1 J = 1 Nm = 1 Ws	1	$2.778 * 10^{-7}$	$2.39 * 10^{-4}$
1 kWh	$3.6 * 10^6$	1	860
1 kcal	$4.187 * 10^3$	$1.163 * 10^{-3}$	1

Specific heat capacity of water: 1.163 Wh/kg K = 4.187 J/kg K = 1 kcal/kg K

Power units

Unit	kJ/h	W	kcal/h
1 kJ/h	1	0.2778	0.239
1 W	3,6	1	0.86
1 kcal/h	4.187	1.163	1

Pressure

Bar	Pascal	Torr	Water column
1	100.000	750 mm HG	10.2 m

Length

Metre	Inch	Foot	Yard
1	39.370	3.281	1.094
0.0254	1	0.083	0.028

Powers

Prefix	Abbreviation	Denotation	Prefix	Abbreviation	Denotation
Deca	da	10^1	Deci	d	10^{-1}
Hecto	h	10^2	Centi	c	10^{-2}
Kilo	k	10^3	Milli	m	10^{-3}
Mega	M	10^6	Micro	µ	10^{-6}
Giga	G	10^9	Nano	n	10^{-9}
Tera	T	10^{12}	Pico	p	10^{-12}
Peta	P	10^{15}	Femto	f	10^{-15}
Exa	E	10^{18}	Atto	a	10^{-18}

1 Selection and Design of Heat Pumps

1.1 Design of Existing Heating Systems - Heat Pumps for the Renovation Market

1.1.1 Heat consumption of the building to be heated

In the case of existing heating systems, the heat consumption of the building to be heated must be recalculated because the existing boiler cannot serve as a gauge for the actual heat consumption. Boilers are - as a rule - overdimensioned and therefore produce a heat pump output which is too large. The actual heat consumption is calculated according to the respective national standards (e.g. EN 12831). However, an approximate estimate can be made on the basis of the existing energy consumption of the living space to be heated and the specific heat demand.

$$Q_N = \frac{\textit{Oil consumption [l/a]}}{\textit{250 [l/a kW]}} \quad [\text{kW}]$$

$$Q_N = \frac{\textit{Natural gas consumption} \quad [m^3/a]}{\textit{250 [m³/a kW]}} \quad [\text{kW}]$$

The specific heat consumption for detached and semi-detached homes built between 1980 and 1994 is around 80 W/m^2. For homes built before 1980 in which no additional heat-insulation measures have been carried out, it is between 100 W/m^2 and 120 W/m^2. In existing systems, the actual state of the system must be taken into consideration.

NOTE

In exceptional cases in which the actual consumption deviates widely from the norm, approximate estimates can also deviate greatly from exact calculations carried out according to the accepted standards.

1.1.2 Determining the required flow temperature

In most oil and gas boiler systems the thermostat is set to a temperature ranging from 70 °C to 75 °C. As a rule, this high temperature is only required for preparing domestic hot water. Downstream regulator systems within the heating system such as mixing and thermostat valves prevent the building from overheating. If a heat pump is retrofitted, it is imperative to calculate the actual flow and return temperatures required so that the correct renovation measures can be determined.

There are two ways of doing this.

a) **The heat consumption calculation and the heat consumption of each room are known.**
The output according to the respective flow and return temperatures is listed in the heat output tables for the radiators (see *Table 1.1 on p. 10*). The room for which the highest temperature is required determines the maximum flow temperature in the heating system.

Cast iron radiators										
Height	mm	980			580			430		280
Depth	mm	70	160	220	110	160	220	160	220	250
Heat output per element in W, at mean water temperature T_m	50 °C	45	83	106	37	51	66	38	50	37
	60 °C	67	120	153	54	74	97	55	71	55
	70 °C	90	162	206	74	99	129	75	96	74
	80 °C	111	204	260	92	126	162	93	122	92

Steel radiators										
Height	mm	1000			600			450		300
Depth	mm	110	160	220	110	160	220	160	220	250
Heat output per element in W, at mean water temperature T_m	50 °C	50	64	84	30	41	52	30	41	32
	60 °C	71	95	120	42	58	75	44	58	45
	70 °C	96	127	162	56	77	102	59	77	61
	80 °C	122	157	204	73	99	128	74	99	77

Fig. 1.1: Heat output of radiator elements (at a room temperature of t_i=20 °C, according to DIN 4703)

b) **Experimental determination during the heating period (see *Fig. 1.2 on p. 11*)**
The flow and return temperatures are continually reduced during the heating period with the thermostat valves fully open until a room temperature of approx. 20-22 °C is reached. Once the desired room temperature has been reached, the actual flow and return temperatures plus the external temperature are noted and entered in the diagram shown below. The **actual** required temperature level (low, medium, or high temperature) can be read from the entered value using this diagram.

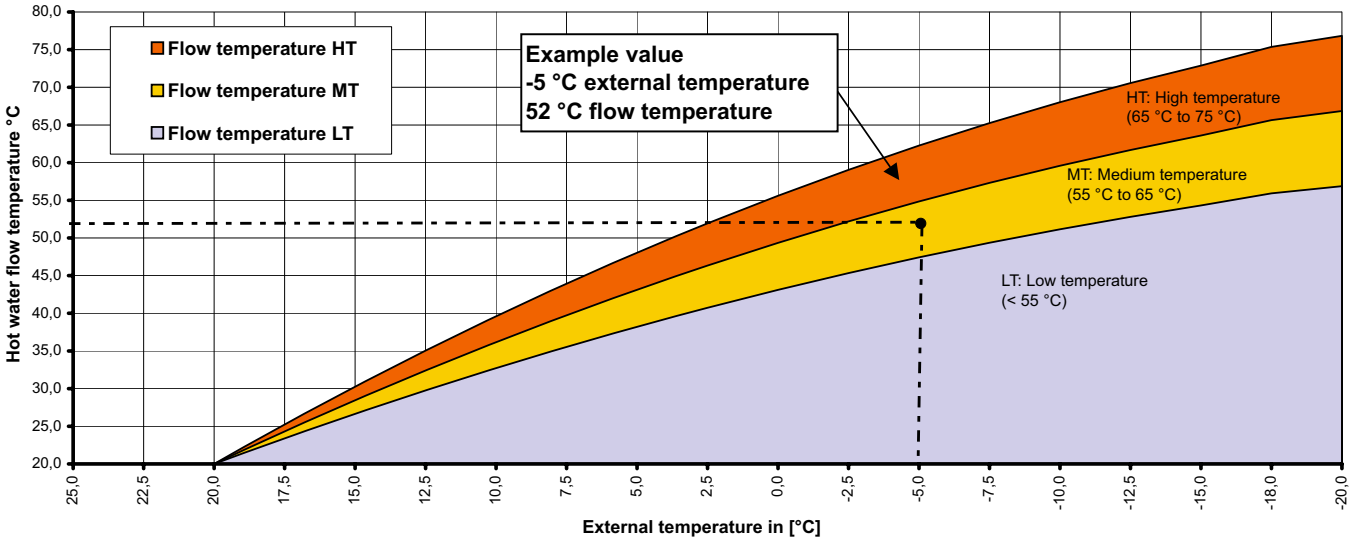


Fig. 1.2: Diagram for experimental determination of the actually required system temperatures

1.1.3 Which renovation measures must be carried out for energy-saving heat pump operation?

Low-temperature
Flow temperature for all rooms max. 55 °C

If the required flow temperature is below 55 °C, no additional measures are required. Any low-temperature heat pump for flow temperatures up to 55° C can be used.

Medium-temperature
Flow temperature in some rooms higher than 55 °C

If the required flow temperature in some rooms is higher than 55 °C, measures must be taken to reduce the required flow temperature. In this case, only the radiators in the affected rooms are replaced to enable the use of a low-temperature heat pump.

Medium-temperature
Flow temperatures in almost all rooms between 55 °C and 65 °C

If temperatures between 55 °C and 65 °C are required in almost all rooms, the radiators in most of the rooms must be replaced. As an alternative, the decision can be made to use a medium-temperature heat pump instead.

High-temperature
Flow temperatures in almost all rooms between 65 °C and 75 °C

If flow temperatures ranging from 65 °C to 75 °C are required, the complete heating system must be converted or adapted. If it is not possible or not desirable to carry out such a conversion, a high-temperature heat pump must be installed instead.

A reduction in heat consumption achieved by

- replacing windows
- reducing ventilation losses
- insulating ceiling spaces, attics and/or facades

yields a savings when retrofitting with a heat pump in four different ways.

a) By reducing the heat consumption, a smaller and therefore cheaper heat pump can be installed.

b) A lower heat consumption leads to a reduction in the annual energy demand which must be met by the heat pump.

c) The lower heat consumption can be met with reduced flow temperatures, which therefore improves the annual performance factor.

d) Improved thermal insulation leads to an increase in the mean surface temperatures of the space-enclosing surfaces. As a result, the same degree of comfort can be achieved at lower room temperatures.

For example:

A house with a heat consumption of 20 kW and an annual energy consumption for heating of approx. 40,000 kWh is heated with a hot water heating system with a flow temperature of 65 °C (return flow 50 °C). By carrying out thermal insulation measures retrospectively, the heat consumption can be cut by 25 % to 15 kW and the annual energy demand for heating can be cut to 30,000 kWH.

In this way, the required flow temperature can be lowered by approx. 10 K, cutting the energy consumption by a further 20 - 25 %. The total savings in energy costs when implementing a heat pump heating system amounts to approx. 44 %.

NOTE

The following generally applies for heat pump heating systems:
Every 1°C reduction in the flow temperature yields a savings in energy consumption of approx. 2.5 %.

1.1.4 Choice of heat source (renovation)

It is rarely possible to install a ground heat collector, borehole heat exchanger or well system in the renovation market for existing houses with landscaped gardens. In most of the cases, the outside air is the only possible heat source.

Air is available everywhere as a heat source and can be used at any time without requiring approval. The annual performance factors which are to be expected are lower than is the case when either water or geothermal systems are implemented. At the

same time, the costs for tapping the heat source system are lower.

Refer to the relevant chapters for further information on how to dimension heat source systems for brine-to-water and water-to-water heat pumps.

1.2 Heat Pumps for New Systems

1.2.1 Calculating the heat consumption of the building

The maximum hourly heat consumption $\dot{Q}_h$ is calculated according to the respective national standards. It is possible to approximately estimate the heat consumption using the living space A (m^2) that is to be heated:

$$\underset{[kW]}{\textit{Heat consumption}} = \underset{[m^2]}{\textit{Heated space}} \cdot \underset{[kW/m^2]}{\textit{specific heat requirement}}$$

$\dot{q}$ = 0.03 kW/m^2	Low-energy house
$\dot{q}$ = 0.05 kW/m^2	Acc. to thermal insulation ordinance 95 and/ or the EnEV minimum insulation standard
$\dot{q}$ = 0.08 kW/m^2	For a house with normal thermal insulation (built approx. in 1980 or later)
$\dot{q}$ = 0.12 kW/m^2	For older walls without special thermal insulation

Table 1.1: Estimated specific heat consumption values

1.2.2 Determining the flow temperatures

When dimensioning the heat distribution system of a heat pump heating system, it should be borne in mind that the required heat consumption should be assigned on the basis of the lowest possible flow temperatures, because every 1 °C reduction in the flow temperature yields a savings in energy consumption of approx. 2.5 %. Extensive heating surfaces, e.g. underfloor heating, are ideal. The required flow temperature should generally be 55 °C max. to enable the use of low-temperature heat pumps. If higher flow temperatures are necessary, medium or high-temperature heat pumps must be used (*Chap. 1.1.3 on p. 11*).

1.2.3 Selecting the heat source

The decision as to whether air, brine (ground heat collector, borehole heat exchanger) or water (well system) should be used as the heat source should be made on the basis of the following factors.

a) **Investment costs**
In addition to the costs for the heat pump and the heating system (radiators and circulation pump), the investment costs are heavily influenced by the costs of tapping the heat source.

b) **Operating costs**
The expected annual performance factors of the heat pump heating system have a large influence on the operating costs. These are primarily affected by the type of heat pump, the average heat source temperature and the required heating flow temperatures.

NOTE

The annual performance factors which can be expected for air-to-water heat pumps are lower than for water and geothermal systems. However, the costs for tapping the heat source system are also lower.

1.3 Additional Power Requirements

1.3.1 Shut-off times of the utility company

Most utility companies offer special agreements with a lower electricity tariff if heat pumps have been installed. According to the German Federal Tariff Ordinance, the utility company may offer such an agreement if it is able to switch off and block heat pumps at times of peak demand in the supply network.

The heat pump is then no longer available for heating the house during these shut-off times. Therefore, surplus energy must be produced during the periods in which the heat pump is not available for use. Hence, the heat pump should be overdimensioned to allow for this.

Utility company shut-off times normally last up to 4 hours a day, which must be allowed for with a factor of 1.2.

Dimensioning

The calculated heat consumption values for heating and domestic hot water preparation should be added together. Unless a second heat generator is additionally used during the shut-off time, the sum of the heat consumption values must be multiplied by the dimensioning factor f:

Basis of the calculation:

$$f = \frac{24h}{Enable\ period} = \frac{24h}{24h - shut\text{-}off\ time}$$

Blocking time (total)	Dimensioning factor
2 h	1.1
4 h	1.2
6 h	1.3

Table 1.2: Dimensioning factor f for taking shut-off times into consideration

The existing heat storage capacity of solidly built houses, particularly those with underfloor heating, is normally sufficient to also bridge longer shut-off times with only a small loss of comfort so that it is not necessary to use a second heat generator (e.g. boiler). However, an increase in output of the heat pump is necessary because of the need for reheating the storage mass.

1.3.2 Domestic hot water preparation

To meet normal requirements regarding comfort, a peak domestic hot water consumption of approx. 80-100 litres per person and per day must be reckoned with based on a hot water temperature of 45 °C. In this case, allowance should be made for a heat output of 0.2 kW per person.

NOTE

The maximum possible number of persons should be assumed when dimensioning and any special usage (e.g. whirlpool) should also be taken into consideration.

It is not necessary to add the hot water energy consumption to the heat consumption of the heating system if domestic hot water is heated with the flange heater at the time of year (e.g. mid-winter) used as the basis for the calculation.

Circulation pipes

Circulation pipes increase the line-side heat consumption of the domestic hot water heating. This increase in consumption that is to be allowed for depends on both the length of the circulation pipes and the quality of the pipe insulation. If a circulation system cannot be dispensed with because of long pipe runs, a circulation pump should be used that can be activated by a flow sensor according to need. Heat consumption for a circulation pipe can be considerable.

NOTE

To be in compliance with Paragraph 12 (4) of the German Energy Efficiency Ordinance, circulation pumps in hot water systems must be equipped with an automatic switch-on/switch-off mechanism.

The surface-related heat loss of the domestic water distribution system depends on both the surface area and the position of the circulation pipework. For a surface area ranging from 100 to 150m and distribution within the thermal envelope, the surface-related heat losses according to the German EnEV are:

- 9.8 [kWh/m^{2}a] with a circulation system
- 4.2 [kWh/m^{2}a] without a circulation system

1.3.3 Hot water heating for a swimming pool

Outdoor swimming pool

The heat consumption for heating the water in an outdoor swimming pool depends strongly on the respective usage.

In terms of size, it can easily be the same as the heat consumption of a house - and in such cases must be calculated separately.

However, if heating is only carried out in the summertime (period not requiring heating), the heat consumption mentioned above can be ignored in certain cases.

An approximate estimation of the heat consumption is dependent on the windage factor, the climatic conditions, the periods of use and whether or not the pool has a cover.

	Water temperature		
	20 °C	24 °C	28 °C
With cover[1]	100 W/m^2	150 W/m^2	200 W/m^2
Without cover Sheltered location	200 W/m^2	400 W/m^2	600 W/m^2
Without cover Partly sheltered location	300 W/m^2	500 W/m^2	700 W/m^2
Without cover Unsheltered location (subject to high winds)	450 W/m^2	800 W/m^2	1,000 W/m^2

1. Reduced values for pools with a cover only refer to private swimming pools used on average up to 2 h per day.

Table 1.3: Reference values for the heat consumption of outdoor swimming pools used between May and September

For initially heating the pool to a temperature of over 20 °C, the quantity of thermal energy required is approx. 12 kWh/m^3 pool volume. Heating-up periods ranging from one to three days are required depending on the size of the pool and the output of the installed heating system.

Indoor swimming pool

- Space heating
  Space heating is carried out using radiators or underfloor heating and/or a heat exchanger in the dehumidification/ ventilation system. In both cases it is necessary to calculate the heat consumption - according to the system installed.
- Hot water heating for a swimming pool
  The heat consumption depends on the pool temperature, the temperature difference between the pool temperature and the room temperature, and the pool usage.

Room temperature	Water temperature		
	20 °C	24 °C	28 °C
23 °C	90 W/m^2	165 W/m^2	265 W/m^2
25 °C	65 W/m^2	140 W/m^2	240 W/m^2
28 °C	20 W/m^2	100 W/m^2	195 W/m^2

Table 1.4: Reference values for the heat consumption of indoor swimming pools

These outputs can be reduced by up to 50 % for private swimming pools with a cover that are used for a maximum of 2 hours per day.

1.3.4 Determining the heat pump output

1.3.4.1 Air-to-water heat pump (mono energy operation)

Air-to-water heat pumps are primarily operated in mono energy systems. The heat pump should fully meet the heat consumption down to an external temperature (bivalence point) of approx. -5 °C. In the event of very low temperatures and high heat consumption, a second, electrically operated heat generator will be activated.

In the case of mono energy systems, dimensioning of the heat pump output has a particularly strong influence on the level of the investment and the annual heating costs. In most cases, the higher the heat pump output, the higher the initial investment and the lower the annual heating costs will be.

Experience has shown that a heat pump should be selected which cuts the heating characteristic curve for a limit temperature (bivalence point) of approx. -5 °C.

According to the DIN 4701 T10 standard, this yields a 2 % ratio for the second heat generator (e.g. heating element) when operated as a bivalent-parallel system.

Fig. 1.3 on p. 14 shows the annual characteristic curve of the external temperature in Essen, Germany. According to this, there are less than 10 days annually with an external temperature under -5 °C.

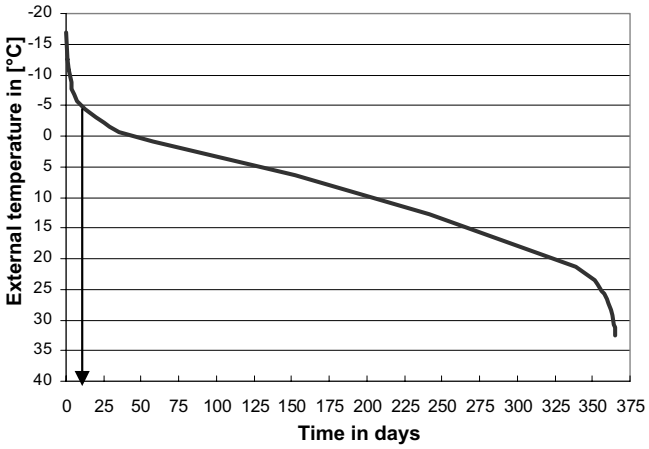


Fig. 1.3: Annual characteristic curve: Number of days on which the external temperature is below the specified value

Example for *Table 1.5 on p. 14*:

A bivalence point of -5 °C yields a heat pump proportion of approx. 98 % for a bivalent-parallel (mono energy) mode of operation.

Bivalence point [°C]	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	1	2	3	4	5
Coverage ratio [-] for biv.-paral. operation	1.00	0.99	0.99	0.99	0.99	0.98	0.97	0.96	0.95	0.93	0.90	0.87	0.83	0.77	0.70	0.61
Coverage ratio [-] for biv.- altern. operation	0.96	0.96	0.95	0.94	0.93	0.91	0.87	0.83	0.78	0.71	0.64	0.55	0.46	0.37	0.28	0.19

Table 1.5: Coverage ratio of the heat pump of a mono energy system or a system operated as a bivalent system according to bivalence point and mode of operation (source: Table 5.3-4 DIN 4701 T10)

1.3.4.2 Dimensioning example for an air-to-water heat pump

- Mono energy mode of operation:
  Heat pump with electric heating element
- Heating system with a maximum flow temperature of 35 °C
- Selected heat consumption of the building to be heated **9.0 kW**
- Additionally selected heat consumption for domestic hot water preparation and swimming pool heating **1.0 kW**
- (heat consumption of the building + additional heat consumption) x factor f from *Table 1.2 on p. 12* (with e.g. a 2-h shut-off time) = (9.0 kW + 1 kW) x 1.1 = **11.0 kW**

= required heat output of the heat pump on the basis of the standard outside temperature according to national standards.

The heat pump is dimensioned on the basis of the heat consumption of the building in relation to the outside temperature (simplified as a straight line) in the heat output diagram and the heat output curve of the heat pump. The building's heat consumption in relation to the external temperature is entered on the basis of the selected room temperature (corresponding to the external temperature point 1) on the horizontal axis (x axis) for the calculated heat output (point 2) for the standard external temperature according to national standards.

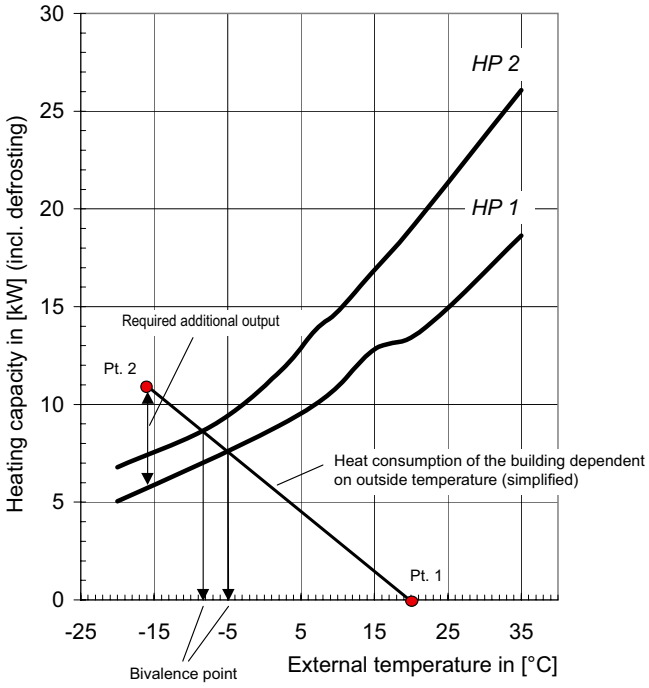


Fig. 1.4: Heat output curves for two air-to-water heat pumps with different heat outputs for flow temperatures of 35 °C and a building heat consumption in relationship to the outside temperature

The approach is illustrated by the example from *Fig. 1.4 on p. 14* with a total heat consumption for the house of 11.0 kW at a standard outside temperature of -16 °C and a selected room temperature of +20 °C. The diagram shows the heat output curves of two heat pumps at a hot water flow temperature of

35 °C. The intersection points (limit temperature or bivalence point) of the straight line of the heat consumption of the building in relation to the outside temperature and the heat output curves of the heat pumps are approx. -5.0 °C for HP 1 and approx. -9 °C for HP 2. HP 1 would be used for the selected example. A supplementary electric heating system is used to enable year-round heating. This compensates for the difference between the heat consumption of the building in relation to the outside temperature and the heat output of the heat pump for the corresponding air intake temperature.

Design of the supplementary electric heating system:

Total heat consumption on the coldest day

– Heat output of the heat pump on the coldest day

= Output of the heating elements

For example:

11 kW	–	5,5 kW	=	5,5 kW
Heat consumption of the building at -16 °C		*Heat output of the HP at -16 °C*		*Output of the heating elements*

HP 1 should be dimensioned with a heating element that has an electrical output of 6.0 kW for the selected example.

1.3.4.3 Water-to-water and brine-to-water heat pumps (monovalent operation)

Total calculated heat consumption = _____**kW**

= Heat output of the heat pump for W10 /W35[1] or BO/W35[1]

1. For monovalent systems, dimensioning should be based on both the maximum flow temperature and the minimum heat source temperature!

NOTE

Refer to the operating instructions of the respective device for the actual heat outputs of water-to-water and brine-to-water heat pumps at each respective flow temperature.

For example:

- Monovalent operation for a heating system with a maximum flow temperature of 35 °C.
- Selected heat consumption of the house to be heated **10.6 kW**
- Heat consumption of the house and components x factor f from *Table 1.2 on p. 12* (for e.g. a 6 h shut off time; f = 1.3) = fictitious total heat consumption.

  Total heat consumption= 10.6 kW x 1.3 = **13.8 kW**

= Heat output of the heat pump

Fig. 1.5 on p. 15 shows the heat output curves of brine-to-water heat pumps. The heat pump to be selected is the one having a heat output which is above the intersection of the required total heat consumption and the temperature of the available heat source.

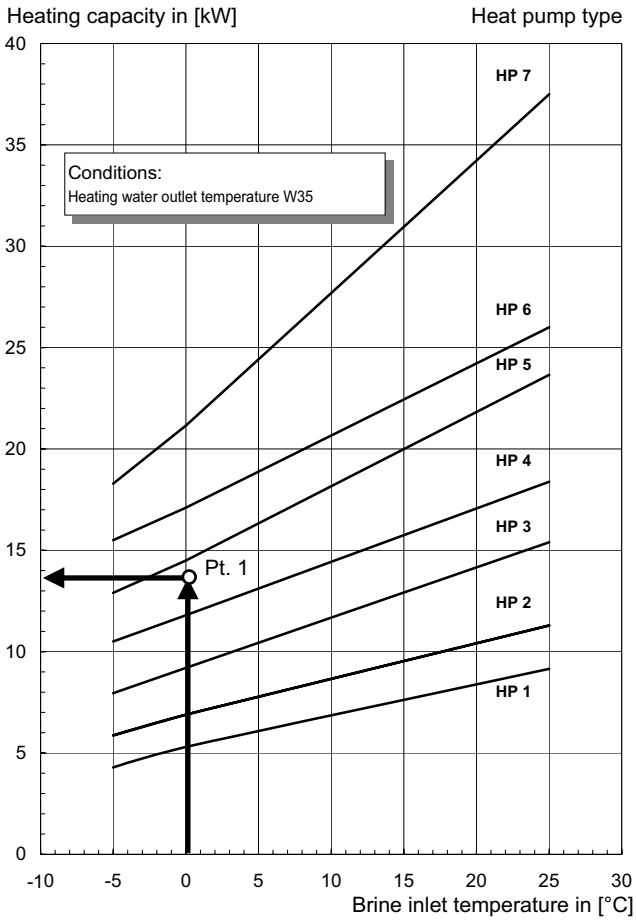


Fig. 1.5: Heat output curves of brine-to-water heat pumps with different heat outputs for flow temperatures of 35 °C.

The output curve of HP 5 must be selected for a maximum required flow temperature of 35 °C for a total heat consumption of 13.8 kW and a minimum brine temperature of 0 °C. This yields a heat output of 14.5 kW for the above boundary conditions.

1.3.4.4 Water-to-water and brine-to-water heat pumps (mono energy operation)

Mono energy brine-to-water or water-to-water heat pump systems are equipped with a second electrically operated heat generator, e.g. a buffer tank with an electric heating element. Mono energy brine-to-water or water-to-water heat pump systems should only be planned in exceptional circumstances if shut-off times mean that large quantities of power must be drawn from the grid or if, on account of the available device range, a heat pump must be selected which has a considerably larger output in comparison to the total heat consumption. Mono energy operation is also particularly suitable for the first heating period if the building is dried out in autumn or in the winter.

Heat pump output

The heat output should be dimensioned for a limit temperature below -10 °C. This yields a heat pump output of 75 % to 95 % measured as a percentage of the total heat consumption based on the lowest external temperature.

Heat source variables

When using earth energy as the heat source (ground source), the ground heat collector or borehole heat exchanger should be dimensioned on the basis of the total heat consumption to ensure that any formation of ice thaws in the spring. When dimensioning the well for water-to-water heat pumps, no further requirements for mono energy operation need to be taken into consideration apart from standard design criteria.

1.3.4.5 Air-to-water heat pump (bivalent operation)

When a system is operated as a bivalent-parallel system (existing older building), a second heat generator (oil or gas boiler) assists the heat pump from the bivalence point of < 4 °C.

It is often useful to select a smaller sized heat pump since the heat pump's percentage of annual heat output fluctuates very little. A prerequisite is that **long-term** operation of a bivalent system is planned.

NOTE

Experience has shown that, in the case of bivalent systems used in modernisation projects, the existing oil or gas boiler will be taken out of service after a few years, for a variety of reasons. Therefore, dimensioning should always be carried out analogue to the mono energy system (bivalence point is approx. -5 °C). At the same time, the buffer tank should also be integrated into the heat flow.

1.3.4.6 Water-to-water and brine-to-water heat pumps (bivalent operation)

The same interrelationships generally apply for bivalent operation of water-to-water and brine-to-water heat pumps as for air-to-water heat pumps. However, other dimensioning factors must be considered depending on the layout of the heat source system.

Ask our heat pump system specialists if you have any questions on this topic.

1.3.4.7 Drying-out of buildings

When a house is being built, large quantities of water are normally used for mortar, rendering, plaster and wall paper, which only evaporates very slowly from the building. In addition, rain can decisively increase the humidity in the building's structure. This increased humidity in the entire structure causes an increase in the heat consumption of the house during the first two heating periods.

For this reason, buildings should be dried out using specially designed dehumidifiers. Particularly if brine-to-water heat pumps are implemented, we recommend installing an additional heating element to compensate for the increased heat consumption if the heat outputs of the heat pump have been marginally calculated and the respective building is to be dried out in autumn or in the winter. In the case of brine-to-water heat pumps, this heating element should then only be activated during the first heating period on the basis of the brine flow temperature (approx. 0 °C) or on the basis of the limit temperature (0 °C to 5 °C).

NOTE

In the case of brine-to-water heat pumps, the increased compressor runtimes could cause the heat source to supercool in turn causing the heat pump to automatically switch off.

2 Air-to-Water Heat Pumps

2.1 The Air as Heat Source

Area of application of air-to-water heat pumps

-25 °C... + 35 °C

Availability of outside air as a heat source

- Unlimited

Types of operation

- Mono energy
- Bivalent-parallel (partial-parallel)
- Alternative bivalent mode
- Bivalent-renewable mode

Buffer tank

The integration of the air-to-water heat pump requires a buffer tank connected in series to ensure that the evaporator (finned heat exchanger) is defrosted by means of reverse circulation. Installation of a buffer tank connected in series also lengthens the runtimes of the heat pump during periods of reduced heating demand (see *Chap. 8.5 on p. 180*).

Condensate outflow

Condensed water that forms during operation must be drained off frost-free. The heat pump must be mounted on a level plane to guarantee proper drainage. The condensed water pipe must have a minimum diameter of 50 mm and should be fed into the sewer for rain water to ensure that large quantities of water can be drained off. Defrosting takes place up to 16 times daily, with up to 3 litres of condensed water being produced each time.

⚠ ATTENTION!

If the condensation is fed into clearing tanks and sewage systems a siphon is required in order to protect the evaporator from damaging vapours.

Recommended Installation

The air-to-water heat pump should preferably be installed outdoors. This is a simple, economical installation option because the requirements placed on the foundations are minimal and this set-up avoids the need for air ducting. If outdoor installation is not possible, it should be kept in mind that condensation can form on the heat pump, on air ducts and especially around wall openings when the heat pump is installed in rooms with high humidity.

⚠ ATTENTION!

The intake air must not contain ammonia. The use of air from animal stables is therefore not permitted.

2.2 Air-to-Water Heat Pumps for Indoor Installation

Costs for indoor installation

- Air circuit (e.g. ducting)
- Wall openings
- Condensate outflow

General information

An air-to-water heat pump should not be installed in the living quarters of a building. In extreme circumstances, outside air as cold as -25 °C may pass through the heat pump. This can lead to the formation of condensation in the area around wall openings and air duct connections in rooms with high humidity, e.g. kitchens and laundry rooms, eventually resulting in damage to the building. The formation of condensation cannot be avoided (even with good thermal insulation) if the ambient air humidity exceeds 50 % and the external temperature is below 0 °C. Therefore, unheated rooms such as cellars, storerooms, and garages are more suitable installation locations.

i NOTE

For a higher degree of sound protection, the air outlet should be over a 90° bend or outdoor installation should (*Chap. 2.4 on p. 24*) be selected.

If the heat pump is installed on an upper storey, the load-bearing capacity of the ceiling should be checked. Installation on a wooden floor is not recommended.

i NOTE

If the heat pump is installed above inhabited rooms, constructional measures for solid-borne sound insulation are required.

Air circuit

Air-to-water heat pumps installed indoors must be supplied with a sufficient air volume flow to ensure efficient and smooth operation. This is based primarily on the heat output of the heat pump and is between 2,500 and 9,000 m^3/h (see *Chap. 2.6 on p. 28*). The minimum dimensions for the air ducting must be observed.

Air circulation from the air intake through the heat pump to the air outlet should be as unhindered as possible so that any unnecessary air resistance is avoided (*Chap. 2.3 on p. 21*).

2.2.1 Requirements placed on the installation location

Ventilation

The room in which the heat pump is installed should preferably be ventilated with outside air so that the relative humidity level remains low and the formation of condensate is avoided. Condensate can form on cold components in particular during start-up of the system and when the building is being dried out.

⚠ ATTENTION!

The heat pump must not be operated without appropriate air circulation because of the risk of injury caused by rotating parts (ventilator).

2.2.2 Air intake and air outlet via light wells

If the wall openings for the air ducting on either the air intake or air outlet are positioned below ground level, it is recommended that the air circuit is routed through plastic light wells which do not impede the air flow. A cowling must be installed if the wells are made of concrete.

- The minimum light well dimensions are 1000x400 mm (Refer to the device information for the minimum dimensions for the air ducting if 2 compressors are installed)
- The transition between the light well and the wall opening (see *Chap. 2.2.4 on p. 18*) should be sealed
- The light well should be covered with a grating (safeguarded against burglary)
- An outlet for condensate must be provided
- A wire grating (0.8 cm > mesh size) should be fitted to prevent small animals from entering and leaves from falling in.

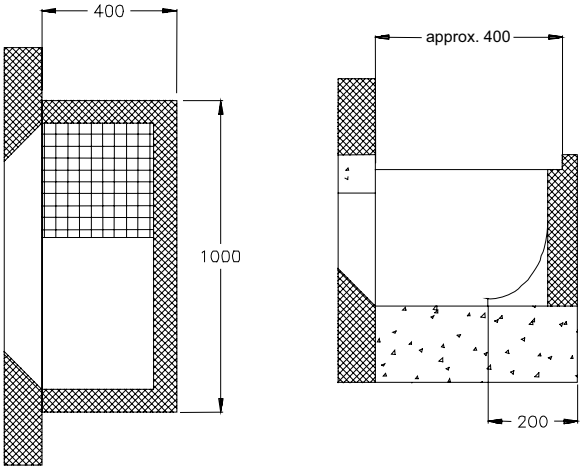


Fig. 2.1: Air inlet openings - light well

2.2.3 Heat pump rain guard

Rain guards act as a visual covering for wall openings above ground and also protect the air ducting from the effects of the weather. They are mounted on outside walls and can therefore be used independent of the type of air circuit. The rain guard (special accessory) has been specially developed for heat pumps and features a significantly lower pressure drop than standard rain guards. It can be used either on the air intake or the air outlet side.

A wire grating should be fitted between the wall and the rain guard to prevent small animals from entering and leaves from falling in. At least 80 % of the grating's cross section must be open (mesh size > 0.8 cm). Measures to safeguard the rain guard against burglary are to take place on site.

Item	Description	500-700	800
1	Rain guard	1 item	1 item
2	Dowel 6 x 30	4 items	6 items
3	Screw 5 x 70	4 items	6 items

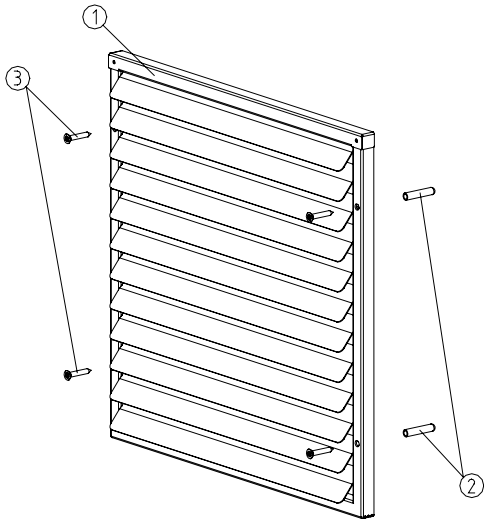


Fig. 2.2: Heat pump rain guard

2.2.4 Insulation of wall openings

Necessary wall openings should be provided on site. It is essential that the interior side of the wall opening in lined with thermal insulation to prevent the wall from becoming cold and to prevent moisture from penetrating the wall. For example, *Fig. 2.3 on p. 18* illustrates insulation using rigid polyurethane foam (25-mm insulation thickness). The transition between the wall insulation and the wall-mounted junction box must be sealed air-tight. Water which has penetrated due to adverse weather conditions (e.g. driving rain) should be routed outside by means of a gradient.

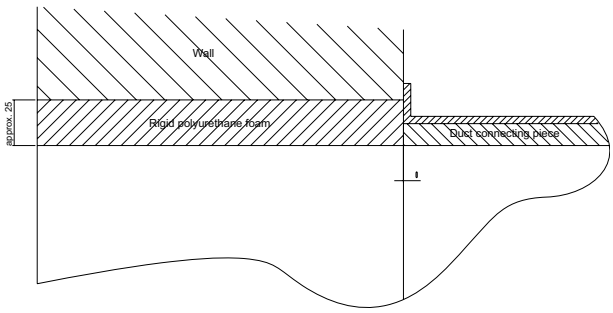


Fig. 2.3: Example of how to construct the wall opening

2.2.5 Air-to-water heat pumps in a compact design for indoor installation

In addition to the heat source, with compact air-to-water heat pumps the components for direct connection of an unmixed heating circuit are integrated.

Air circuit diverted at a 90° angle or on walls

The heat pump allows for installation in a corner without additional ducts. Wall installation is also possible in combination with an air duct on the air outlet side.

The base frame must rest on a smooth, even and level surface. The heat pump must be installed so that maintenance work can be carried out without hindrance. This can be ensured by maintaining a clearance of 1 m in front and to the left of the heat pump.

The air intake opening of the device is designed for direct connection to a wall opening. This is done by attaching the self-adhesive sealing ring supplied and gently pushing the device against the wall. It is essential that the interior side of the wall opening is lined with thermal insulation (see *Fig. 2.4 on p. 19*) to prevent the wall from becoming cold and to prevent moisture from penetrating the wall (i.e. rigid polyurethane foam/aluminium foil)

The air outlet can be optionally mounted directly to a wall opening or to one of the GRC ducts available as accessories (see *Fig. 2.4 on p. 19* and *Fig. 2.5 on p. 19*).

The following air circuit components are available for compact air-to-water heat pumps.

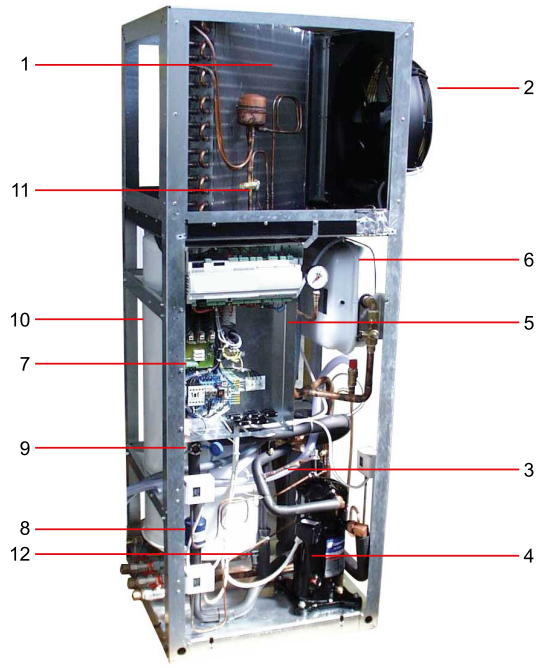
- RSG 500 rainguard
- Air ducts (LKL, LKB, LKK 500)
- DMK 500 sealing collar

Please observe the notes in *Chap. 2.2.5 on p. 19* when using the GRC air ducts available as accessories.

Basic Device

The heat pump is supplied complete with all of the important components of the heating circulation system:

- Heat pump managers
- Expansion vessel (24 litre, 1.0 bar admission pressure)
- Heat circulating pump
- Overflow valve and safety components
- Buffer tank
- Supplementary electric heating system 2 kW



1) Evaporator
2) Ventilator
3) Liquefier
4) Compressor
5) Heat circulating pump
6) Expansion vessel 24 l
7) Switch Box
8) Filter dryer
9) Inspection window
10) Buffer tank
11) Expansion valve
12) Overflow valve

Installation example

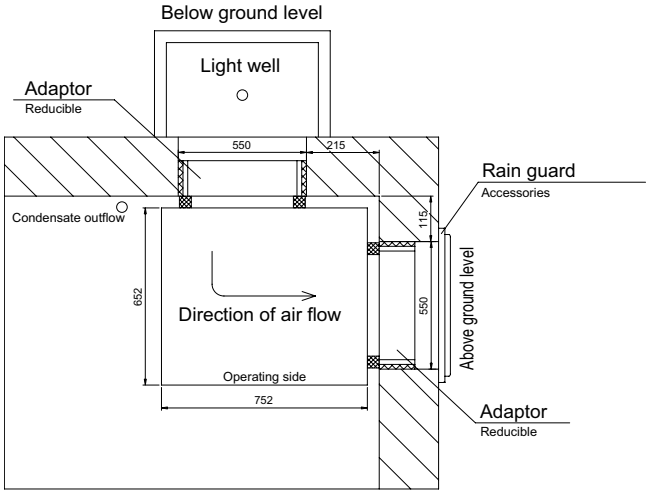


Fig. 2.4: Corner installation 500 with wall opening insulated on site. An adaptor (duct section) can also be used as insulation (*Fig. 2.11 on p. 57*)

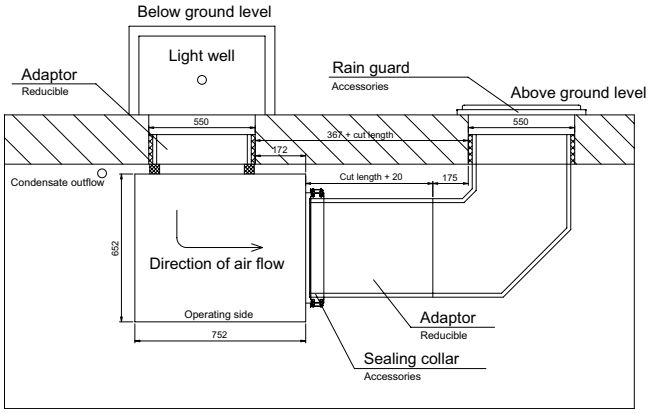


Fig. 2.5: Wall installation 500 with GRC air duct

2.2.6 Air duct hose set for air-to-water heat pumps (indoor installation)

Flexible hoses are offered as accessories for the air circuit for the air-to-water heat pumps LI 11TE and LI 16TE. The air duct hose set is suitable for use in rooms with low temperatures and low humidity. It contains a 5m length of thermally-insulated and sound-insulated air hose which can be used for both the air intake and the air outlet side. Air intake and air outlet can take place via a light well or a rain guard. Installation material for connection to the heat pump and for the wall opening to be insulated on site is included.

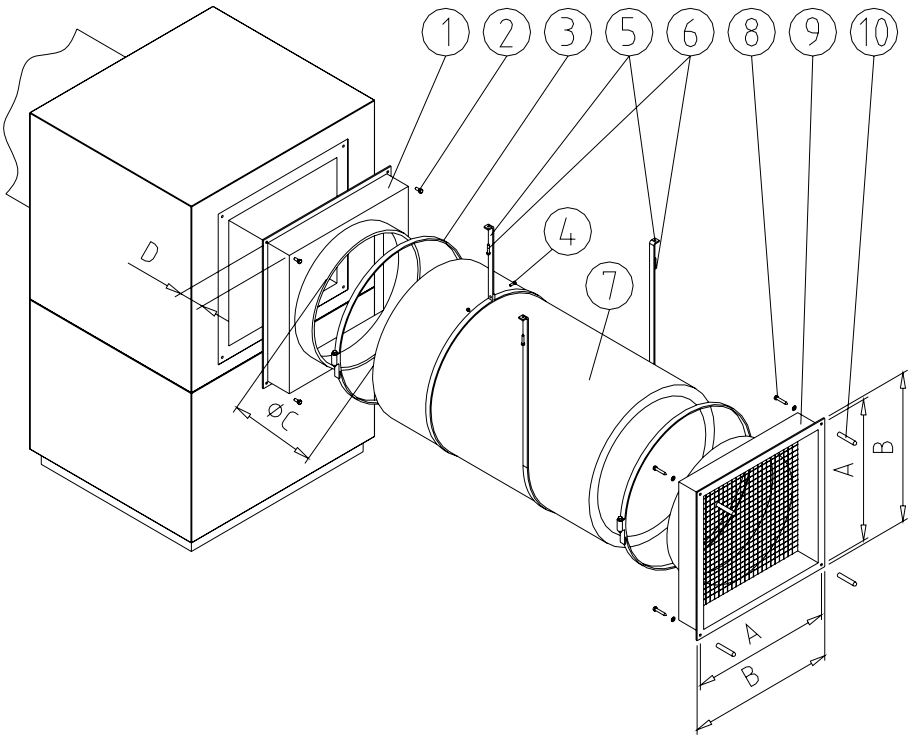
Air hoses have the advantage that they can be individually adapted on site and are able to simply and quickly compensate for height and length differences. In addition, air hoses have both a thermal and sound insulating effect and prevent the room in which the system is installed from becoming cold. A grid on the wall connection stubs prevents small animals from entering and leaves from falling in.

NOTE

The minimum air flow should be checked if there is a 90° air deflection on either the air intake or the air outlet side.

Dimensions in mm	DN 500	DN 630
A	560	652
B	585	670
ØC	495	625
D	100	100

Table 2.1: Dimensions of the air duct hose set



Scope of supply

1) Heat pump connecting stubs
2) Hexagon bolt
3) Connection clamp
4) Hexagon bolt
5) Perforated steel ribbon
6) Dowel
7) Connecting hose with insulation thickness of 25 mm
8) Screw
9) Connecting stubs (wall-mounted)
10) Dowel

Minimum bend radius LUS 11: 300 mm

Minimum bend radius LUS 16: 400 mm

Space requirement for 90° bend: approx. 1 m

Fig. 2.6: Air duct hose set

2.2.7 GRC air ducts for air-to-water heat pumps (indoor installation)

The glass fibre reinforced concrete air ducts offered as accessories are moisture-resistant and diffusion-free. They are supplied in each respective cross section as 90° bends and as 625 mm and 1,250mm extensions.

The formation of condensate is avoided due to the internal insulation consisting of mineral wool and foil-clad glass fibre mat, resulting in a clear reduction in sound transmissions. The ends are fitted with zinc-plated pressed steel frames.

The ducts can be painted with standard emulsion paint according to need.

Minor damage to the outer surface has no affect on the efficiency and can be repaired with standard plaster.

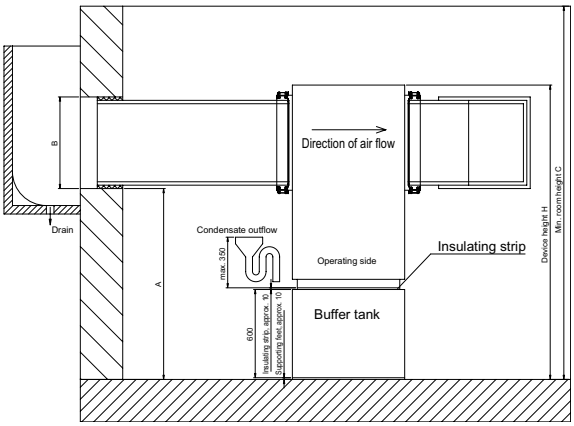


Fig. 2.7: Air-to-water heat pumps with GRC air ducts and built-under buffer tank

Assembly of a standard installation set-up:

Air ducts can be mounted as delivered if a standard installation set-up (see *Chap. 2.3.1 on p. 22*) is selected.

The minimum clearances from the heat pump to the walls (see *Fig. 2.8 on p. 21*) should always be observed when positioning the air circuit.

The air ducts or bends are sealed in the wall opening with standard polyurethane foam in accordance with the dimensions in the drawing. The ducts are supported at regular intervals from below or using threaded rods from the ceiling.

NOTE

For solid-borne sound insulation, the air ducts are not screwed directly onto the heat pump.

A clearance of approx. 2cm should be left between the heat pump and the ducting to simplify future disassembly of the heat pump. The seal to the heat pump is made with the sealing collar which is available as an accessory (see *Fig. 2.9 on p. 21*).

Butt joint between two duct sections:

The duct sections are equipped with a metal fixing frame to facilitate connection. Using these fixing frames for connection avoids air turbulence and the resulting pressure drops.

The components are sealed off from one another by gluing standard foam rubber between the metal frames or by applying silicon sealant between the metal frames.

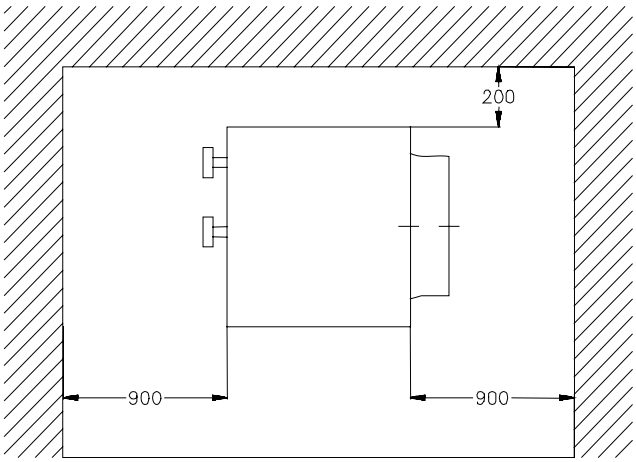


Fig. 2.8: Minimum clearances for indoor installation of the air-to-water heat pump

Cutting lengths:

Existing air ducts can be shortened or adapted on site using the conversion kit available as an accessory. The resulting cut edges are coated with a suitable adhesive paste (i.e. silicon) and the ends are then fitted with zinc-plated channel sections.

When determining where to make the cut, it should be noted that straight ducts are equipped with the tab required for connection at one end only.

The duct sections can be cut with standard woodworking tools such as e.g. a circular saw or jigsaw. Carbide or diamond-tipped tools are recommended.

Sealing collar

The sealing collar is used to seal the glass fibre reinforced concrete air ducts on the heat pump. The air ducts are not screwed directly onto the heat pump. Only the rubber seal comes into direct contact with the heat pump when the system is installed correctly. This guarantees easy assembly and disassembly of the heat pump and also ensures that solid-borne sound is well insulated.

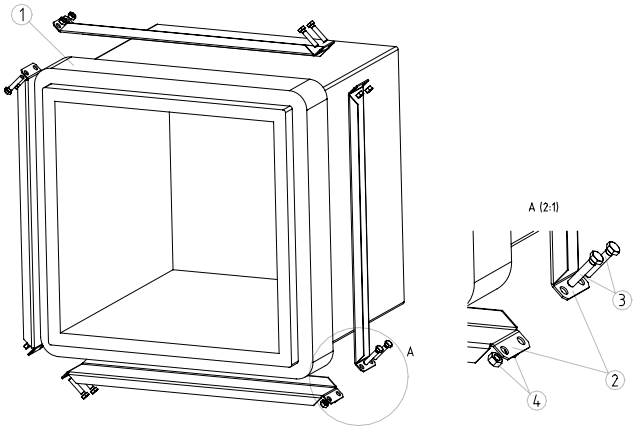


Fig. 2.9: Sealing collar for air ducts

2.3 Dimensioning the Air Circuit

It should be borne in mind when dimensioning the air circuit (air intake and air outlet) that the maximum pressure drop (max. compression) of the individual components must not exceed the value listed in the device information (see *Chap. 2.6 on p. 28*). Both cross sectional areas which are too small and deflections (e.g. rain guard) which are too extreme can cause impermissibly high pressure drops and lead to ineffective or faulty operation.

Air circuit components	Pressure drop
Air duct straight	1 Pa/m
Air duct bend	7 Pa
Rain guard	5 Pa
Light well air intake	5 Pa
Light well air outlet	7-10 Pa

Table 2.2: Reference values for the air circuit system accessories

NOTE

The air circuit within the building should have a maximum of two 90° deflections to ensure compliance with the maximum permissible pressure drops.

The air circuit components available as special accessories are designed such that their values are below the permissible compressions for the standard installation set-ups shown (see *Chap. 2.3.1 on p. 22*). This means that it is not necessary to check the overall pressure drop. A light well or a wall opening with a rain guard can be used for the air intake and air outlet.

The overall pressure drop, which is the sum of the individual pressure drops from the air intake to the air outlet, must not exceed the value given in the device information (see *Chap. 2.6 on p. 28*). Grids, light wells, tight bends, air ducting and air hoses should also be taken into consideration.

⚠ ATTENTION!

The minimum air flow should be checked whenever the set-up deviates from the standard connections or third-party air circuit components are fitted.

Selection of air circuit components

The following air circuit components are available in four different sizes to correspond to the available performance levels:

- Rain guard
- Air duct (duct/bend)
- Sealing collars

Device type	Air circuit components
LIK 8ME / LIK 8TE / LI 9TE	Type 500
LI 11ME / LI 11TE	Type 600
LI 16TE / LI 20TE	Type 700
LI 24TE / LI 28TE	Type 800
LIH 22TE / LIH 26TE	Type 800

Table 2.3: Allocation of air circuit components

2.3.1 Height dimensions for use of glass fibre concrete ducts

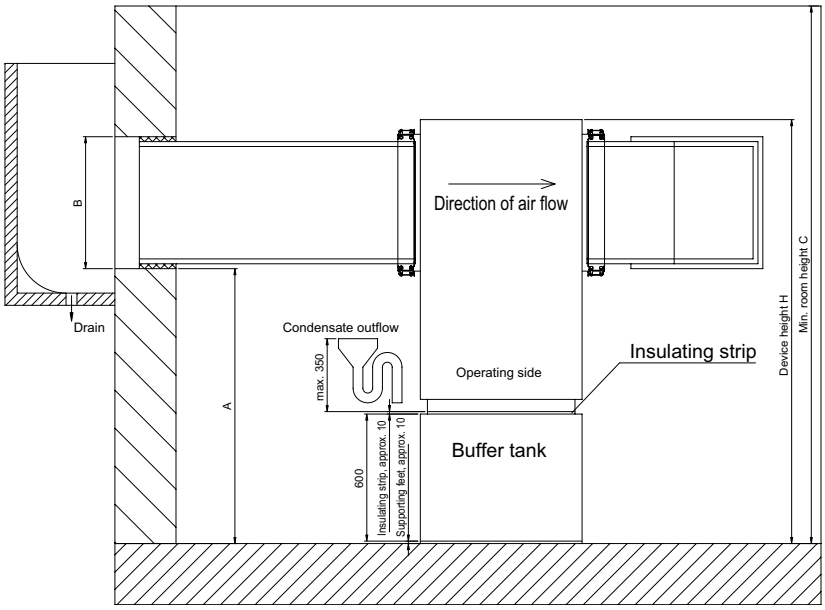


Fig. 2.10: Front view 600-800

Built-under buffer tank

The 140 litre built-under buffer tank is suitable for all LI 11TE, LI 16TE and LI 20TE heat pumps installed indoors, because it increases the overall height of the construction, allowing the air ducts to be installed directly below the ceiling.

Type	Heat Pump	A (in mm) with buffer	A (in mm) without buffer	B (in mm)	C (in mm)	H (in mm) with buffer	H (in mm) without buffer
500	LIK 8ME / LIK 8TE	–	1328	550	2100	–	1911
500	LI 9TE	–	678	550	2100	–	1261
600	LI 11ME / LI 11TE	1282	672	650	2200	1981	1371
700	LI 16TE / LI 20TE	1340	730	745	2400	2191	1581
800	LI 24TE - LI 28TE / LIH 22TE - LIH 26TE	–	762	820	2000	–	1721

Table 2.4: Table of dimensions for front view 600-800 (LIK 8TE / LI 9TE see *Chap. 2.2.5 on p. 19*)

The dimensions for the installation of the heat pump and the position of the wall openings are determined as follows:

1. Step: Determine the type of air circuit components required depending on the type of air-to-water heat pump to be installed according to *Table 2.3 on p. 22*.

2. Step: Select the required installation version.

3. Step: Extract the required values pertaining to the respective installation version from the table of dimensions.

2.3.2 Installation in a corner

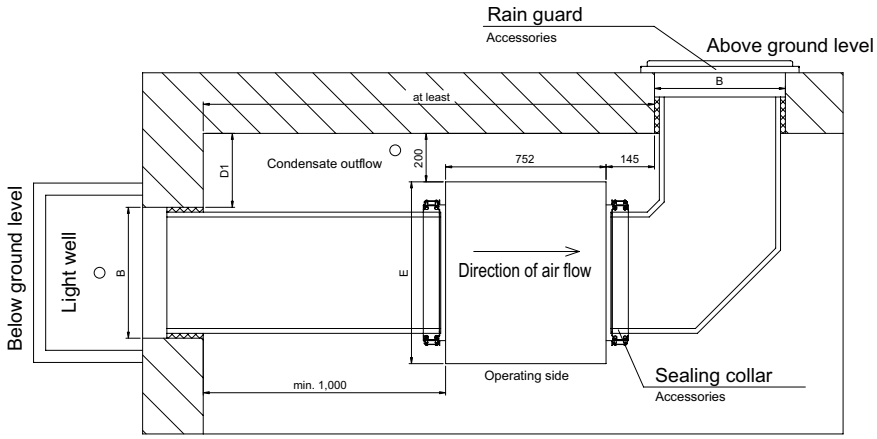


Fig. 2.11: Corner installation (LIK 8TE / LI 9TE see *Chap. 2.2.5 on p. 19*)

Type	Heat Pump	B (in mm)	D1 (in mm)	E (in mm)
600	LI 11ME / LI 11TE	650	301	852
700	LI 16TE / LI 20TE	745	254	852
800	LI 24TE - LI 28TE / LIH 22TE - LIH 26TE	820	291	1002

Table 2.5: Table of dimensions for installation in a corner

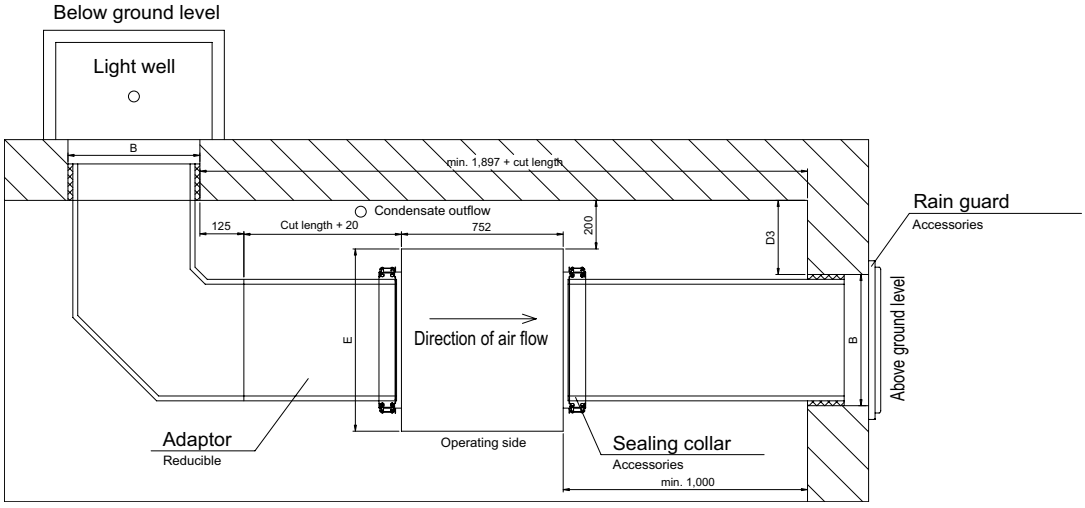


Fig. 2.12: Corner installation with adaptor (LIK 8TE / LI 9TE see *Chap. 2.2.5 on p. 19*)

Type	Heat Pump	B (in mm)	D3 (in mm)	E (in mm)
600	LI 11ME / LI 11TE	650	301	852
700	LI 16TE / LI 20TE	745	254	852
800	LI 24TE - LI 28TE / LIH 22TE - LIH 26TE	820	291	1002

Table 2.6: Table of dimensions for installation in a corner with adaptor

2.3.3 Installation on a wall

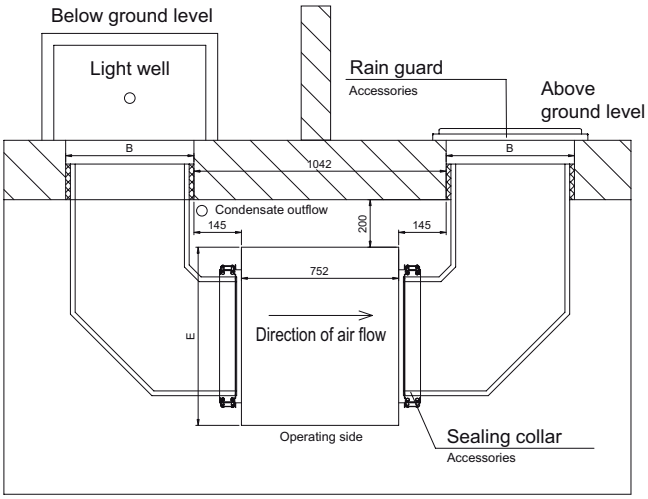


Fig. 2.13: Wall installation (LIK 8TE / LI 9TE see *Chap. 2.2.5 on p. 19*)

Type	Heat Pump	B (in mm)	E (in mm)
600	LI 11ME / LI 11TE	650	852
700	LI 16TE / LI 20TE	745	852
800	LI 24TE - LI 28TE / LIH 22TE - LIH 26TE	820	1002

Table 2.7: Table of dimensions for installation on a wall

NOTE

Either a light well or a rain guard should be used for the air outlet to avoid shorting the air circuit.

2.4 Air-to-Water Heat Pumps for Outdoor Installation

Costs for outdoor installation

- Frost-free established foundation
- Laying insulating heating pipes for flow and return flow in the ground
- Laying electrical connecting and main cables in the ground.
- Wall openings for connecting pipes
- Condensate outflow (frost-free)

Set-up

Heat pumps for outdoor installation are equipped with specially coated steel and are thereby weatherproof.

The device should always be installed on a permanently even and horizontal surface. Frost-free paving slabs or foundations are suitable as a base. The entire frame should lie directly on the ground to ensure a good soundproof seal and to prevent the water-bearing components from becoming too cold. If there are any gaps, these should be sealed with weatherproof insulating material.

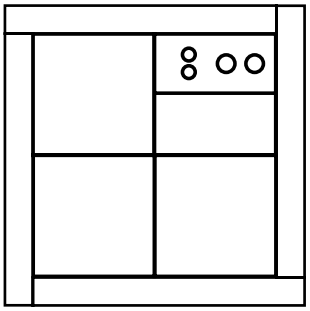


Fig. 2.14: Example for the foundation plan of a heat pump with 4 lawn edging stones and 4 paving slabs

Minimum clearances

It must be possible to carry out maintenance work without hindrance. This can be ensured by maintaining a clearance of 1.2 m to thick walls.

Sound insulation measures

The lowest noise emissions are achieved if, from the air outlet side at a surrounding distance of 3-5 meters, there is no sound reflection through sound-proof surfaces (i.e. facade).

Additionally, the foundation can be covered up to the height of the covering panels with sound-absorbing material (i.e. bark mulch).

Noise emissions from the heat pumps depend on the respective sound power levels and the installation conditions. Please refer to *Chap. 5 on p. 144* for more detailed information about the interrelationship between the factors influencing acoustic emissions, sound propagation and acoustic immissions.

Shorting of the air circuit

When installing the heat pump, please keep in mind that the air cooled by the extraction of heat is blown out freely. For installation close to a wall, the air outlet cannot face in the wall's direction.

Installation in a hollow or in an inner courtyard is not permitted because cooled air collects at ground level and is drawn in again by the heat pump during lengthy operation.

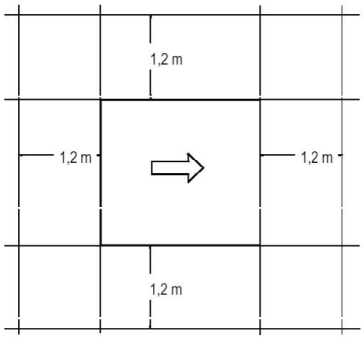


Fig. 2.15: Minimum clearances for maintenance work

Heating system connection

The domestic heating system is connected using two thermally insulated flow and return flow pipes. They are laid underground and are routed through a wall opening into the boiler room, as are the power supply and the control lines (minimum diameter of ductwork DN 70).

NOTE

The distance between the building and the heat pump has an influence on the pressure drop and the heat loss of the connecting pipes and must be taken into consideration when dimensioning the circulating pump and the thickness of the insulation. Pipe lengths of over 30 m should be avoided, as the maximum length of the electric connecting cable is 30 m.

The connections of the heat pump are routed out of the device in a downwards direction. Refer to the respective foundation plans in the dimensional drawings (see *Chap. 2.11 on p. 57*) for the location of the heating pipes and the condensate outflow.

NOTE

To facilitate installation when using insulated district heating lines, it is recommended to leave these at the base frame of the heat pump and to set-up the connection to the heat pump using flexible hoses.

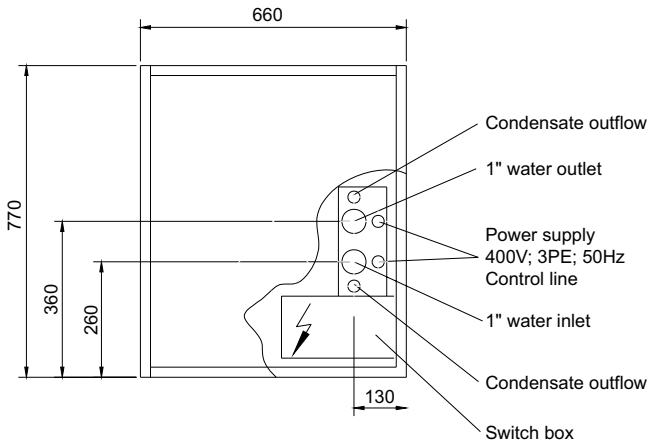


Fig. 2.16: Foundation plan with location of the supply lines for a LA 9PS heat pump

Condensate outflow

With outdoor installation, the condensation can be fed into the rain water canal. The condensed water pipe (diameter minimum 50 mm) should be directed downwards as upright as possible and not be twisted until it is beneath the frost line. The flow must have a sufficient slope downwards.

Flow temp. limit

The heat circulating pump is activated automatically by an integral flow sensor according to need to prevent the heat pump from freezing when it is not in service.

2.5 Device Information for Air-to-Water Heat Pumps for Indoor Installation (1-phase, 230 V AC)

2.5.1 Low-temperature heat pumps with the air circuit diverted at a 90° angle LIK 8ME

Device information for air-to-water heat pumps for heating purposes					
1	**Type and order code**			LIK 8ME	
2	**Design**				
2.1	**Design**			Compact	
2.2	**Degree of protection according to EN 60 529 for compact devices and heating components**			IP20	
2.3	**Installation location**			Indoors	
3	**Performance data**				
3.1	**Operating temperature limits:**				
	Heating water flow/return flow		**°C / °C**	up to 58 / above 18	
	Air		**°C**	-25 to +35	
3.2	**Temperature spread of heating water at A7 / W35**			10.0	5.0
3.3	**Heat output / COP**	**at A-7 / W35 [1]**	**kW / ---**	5.8 / 2.7	5.5 / 2.6
		at A-7 / W45 [1]	**kW / ---**		5.4 / 2.1
		at A2 / W35 [1]	**kW / ---**	7.5 / 3.3	7.4 / 3.2
		at A7 / W35 [1]	**kW / ---**	9.3 / 3.9	9.2 / 3.8
		at A7 / W45 [1]	**kW / ---**		8.8 / 3.2
		at A10 / W35 [1]	**kW / ---**	9.8 / 4.1	9.7 / 4.0
3.4	**Sound power level device / outdoors**		**dB(A)**	53 / 60	
3.5	**Sound pressure level at a distance of 1m (indoors)**		**dB(A)**	48.0	
3.6	**Heating water flow with an internal pressure differential of [2] m³/h / Pa**			0.8 / 2700	1.6 / 11900
3.7	**Free compression of heat circulating pump (max. level)**		**Pa**	45000	27000
3.8	**Air flow with an external static pressure differential of**		**m³/h / Pa**	2500 / 20	
3.9	**Refrigerant; total filling weight**		**type / kg**	R404A / 2.0	
3.10	**Output of electric heating element (2nd heat generator)**		**kW**	2.0	
4	**Dimensions, connections and weight**				
4.1	**Device dimensions**		**H x W x L cm**	190 x 75 x 68	
4.2	**Device connections to heating system**		**Inch**	Thread 1" external	
4.3	**Air duct inlet and outlet (min. internal dimensions)**		**L x W cm**	44 x 44	
4.4	**Weight of the transportable unit(s) incl. packing**		**kg**	245	
4.5	**Buffer tank volume**		**l**	50	
4.6	**Buffer tank pressure rating**		**bar**	6	
5	**Electrical connection**				
5.1	**Nominal voltage; fuse protection**		**V / A**	230 / 20	
5.2	**Nominal power consumption [1]**	**A2 W35**	**kW**	2.27	2.33
5.3	**Starting current with soft starter**		**A**	30	
5.4	**Nominal current A2 W35 / cosφ**		**A / ---**	12.3 / 0.8	12.7 / 0.8
6	**Complies with the European safety regulations**			[3]	
7	**Additional model features**				
7.1	**Defrosting**			Automatic	
	Type of defrosting			Reverse circulation	
	Defrosting tray included			Yes (heated)	
7.2	**Heating water in device protected against icing [4]**			Yes	
7.3	**Performance levels**			1	
7.4	**Controller internal/external**			Internal	

1. This data indicates the size and capacity of the system according to EN 255 or EN 14511. For an analysis of the economic and energy efficiency of the system, other parameters, such as, in particular, the defrosting capacity, the bivalence point and regulation, should also be taken into consideration. The specified values, e.g. A2 / W55, have the following meaning: External temperature 2 °C and heating water flow temperature 55 °C.
2. The heat circulating pump is integrated.
3. See CE declaration of conformity
4. The heat circulating pump and the heat pump controller must always be ready for operation.

2.5.2 Low-temperature heat pumps with horizontal air circuit LI 11ME

Device information for air-to-water heat pumps for heating purposes					
1	**Type and order code**			LI 11ME	
2	**Design**				
2.1	**Degree of protection according to EN 60 529 for compact devices and heating components**			IP21	
2.2	**Installation location**			Indoors	
3	**Performance data**				
3.1	**Operating temperature limits:**				
	Heating water flow/return flow		**°C / °C**	up to 58 / above 18	
	Air		**°C**	-25 to +35	
3.2	**Temperature spread of heating water (flow/return flow) at A7 / W35K**			9.4	5.0
3.3	**Heat output / COP**	**at A-7 / W35 [1]**	**kW / ---**	7.6 / 2.9	7.7 / 2.7
		at A-7 / W45 [1]	**kW / ---**		6.9 / 2.3
		at A2 / W35 [1]	**kW / ---**	9.1 / 3.4	9.0 / 3.3
		at A7 / W35 [1]	**kW / ---**	10.9 / 4.1	10,9 / 3.9
		at A7 / W45 [1]	**kW / ---**		9.2 / 3.4
		at A10 / W35 [1]	**kW / ---**	12.0 / 4.6	11.9 / 4.4
3.4	**Sound power level device / outdoors**		**dB(A)**	55 / 61	
3.5	**Sound pressure level at a distance of 1 m (indoors)**		**dB(A)**	50	
3.6	**Heating water flow with an internal pressure differential of**		**m³/h / Pa**	1.0 / 3000	1.9 / 10900
3.7	**Air flow with an external static pressure differential of**		**m³/h / Pa**	4200 / 0	
			m³/h / Pa	2500 / 25	
3.8	**Refrigerant; total filling weight**		**type / kg**	R404A / 2.5	
4	**Dimensions, connections and weight**				
4.1	**Device dimensions**		**H x W x L cm**	136 x 75 x 88	
4.2	**Device connections to heating system**		**Inch**	Thread 1 1/4" external	
4.3	**Air duct inlet and outlet (min. internal dimensions)**		**L x W cm**	50 x 50	
4.4	**Weight of the transportable unit(s) incl. packing**		**kg**	200	
5	**Electrical connection**				
5.1	**Nominal voltage; fuse protection**		**V / A**	230 / 25	
5.2	**Nominal power consumption [1] A2 W35**		**kW**	2.65	2.71
5.3	**Starting current with soft starter**		**A**	38	
5.4	**Nominal current A2 W35 / cosφ**		**A / ---**	14.4 / 0,8	14.7 / 0.8
6	**Complies with the European safety regulations**			[2]	
7	**Additional model features**				
7.1	**Defrosting**			Automatic	
	Type of defrosting			Reverse circulation	
	Defrosting tray included			Yes (heated)	
7.2	**Heating water in device protected against icing [3]**			Yes	
7.3	**Performance levels**			1	
7.4	**Controller internal/external**			Internal	

1. This data indicates the size and capacity of the system according to EN 255 or EN 14511. For an analysis of the economic and energy efficiency of the system, other parameters, particularly the defrosting capacity, the bivalence point and regulation, should also be taken into consideration. The specified values, e.g. A2 / W55, have the following meaning: 2 °C external air temperature and 55 °C heating water flow temperature.
2. See CE declaration of conformity
3. The heat circulating pump and the heat pump controller must always be ready for operation.

2.6 Device Information for Air-to-Water Heat Pumps for Indoor Installation (3-phase, 400 V AC)

2.6.1 Low-temperature heat pumps with the air circuit diverted at a 90° angle LIK 8TE

Device information for air-to-water heat pumps for heating purposes					
1	**Type and order code**			LIK 8TE	
2	**Design**				
2.1	**Design**			Compact	
2.2	**Degree of protection according to EN 60 529 for compact devices and heating components**			IP20	
2.3	**Installation location**			Indoors	
3	**Performance data**				
3.1	**Operating temperature limits:**				
	Heating water flow/return flow		**°C / °C**	up to 58 / above 18	
	Air		**°C**	-25 to +35	
3.2	**Temperature spread of heating water at A7 / W35**			10.0	5.0
3.3	**Heat output / COP**	**at A-7 / W35 [1]**	**kW / ---**	5.8 / 2.7	5.5 / 2.6
		at A-7 / W45 [1]	**kW / ---**		5.4 / 2.1
		at A2 / W35 [1]	**kW / ---**	7.5 / 3.3	7.4 / 3.2
		at A7 / W35 [1]	**kW / ---**	9.3 / 3.9	9.2 / 3.8
		at A7 / W45 [1]	**kW / ---**		8.8 / 3.2
		at A10 / W35 [1]	**kW / ---**	9.8 / 4.1	9.7 / 4.0
3.4	**Sound power level device / outdoors**		**dB(A)**	53 / 60	
3.5	**Sound pressure level at a distance of 1m (indoors)**		**dB(A)**	48.0	
3.6	**Heating water flow with an internal pressure differential of [2]**		**m³/h / Pa**	0.8 / 2700	1.6 / 11900
3.7	**Free compression of heat circulating pump (max. level)**		**Pa**	45000,0	
3.8	**Air flow with an external static pressure differential of**		**m³/h / Pa**	2500 / 20	
3.9	**Refrigerant; total filling weight**		**type / kg**	R404A / 2.0	
3.10	**Output of electric heating element (2nd heat generator)**		**kW**	2,0	
4	**Dimensions, connections and weight**				
4.1	**Device dimensions**		**H x W x L cm**	190 x 75 x 68	
4.2	**Device connections to heating system**		**Inch**	Thread 1" external	
4.3	**Air duct inlet and outlet (min. internal dimensions)**		**L x W cm**	44 x 44	
4.4	**Weight of the transportable unit(s) incl. packing**		**kg**	245	
4.5	**Buffer tank volume**		**l**	50	
4.6	**Buffer tank pressure rating**		**bar**	6	
5	**Electrical connection**				
5.1	**Nominal voltage; fuse protection**		**V / A**	400 / 16	
5.2	**Nominal power consumption [1]**	**A2 W35**	**kW**	2.27	2.33
5.3	**Starting current with soft starter**		**A**	19,5	
5.4	**Nominal current A2 W35 / cosφ**		**A / ---**	4.1 / 0.8	4.2 / 0.8
6	**Complies with the European safety regulations**			[3]	
7	**Additional model features**				
7.1	**Defrosting**			Automatic	
	Type of defrosting			Reverse circulation	
	Defrosting tray included			Yes (heated)	
7.2	**Heating water in device protected against icing [4]**			Yes	
7.3	**Performance levels**			1	
7.4	**Controller internal/external**			Internal	

1. This data indicates the size and capacity of the system according to EN 255 or EN 14511. For an analysis of the economic and energy efficiency of the system, other parameters, such as, in particular, the defrosting capacity, the bivalence point and regulation, should also be taken into consideration. The specified values, e.g. A2 / W55, have the following meaning: External temperature 2 °C and heating water flow temperature 55 °C.
2. The heat circulating pump is integrated.
3. See CE declaration of conformity
4. The heat circulating pump and the heat pump controller must always be ready for operation.

2.6.2 Low-temperature heat pumps with the air circuit diverted at a 90° angle LI 9TE

Device information for air-to-water heat pumps for heating purposes					
1	**Type and order code**			LI 9TE	
2	**Design**				
2.1	**Degree of protection according to EN 60 529 for compact devices and heating components**			IP21	
2.2	**Installation location**			Indoors	
3	**Performance data**				
3.1	**Operating temperature limits:**				
	Heating water flow/return flow		**°C / °C**	up to 58 / above 18	
	Air		**°C**	-25 to +35	
3.2	**Temperature spread of heating water (flow/return flow) at A7 / W35**		**K**	10.0	5.0
3.3	**Heat output / COP**	**at A-7 / W35 [1]**	**kW / ---**	5.8 / 2.7	5.5 / 2.6
		at A-7 / W45 [1]	**kW / ---**		5,4 / 2,1
		at A2 / W35 [1]	**kW / ---**	7.5 / 3.3	7.4 / 3.2
		at A7 / W35 [1]	**kW / ---**	9.3 / 3.9	9.2 / 3.8
		at A7 / W45 [1]	**kW / ---**		8.8 / 3.2
		at A10 / W35 [1]	**kW / ---**	9.8 / 4.1	9.7 / 4.0
3.4	**Sound power level device / outdoors**		**dB(A)**	53 / 60	
3.5	**Sound pressure level at a distance of 1 m (indoors)**		**dB(A)**	48.0	
3.6	**Heating water flow with an internal pressure differential of**		**m³/h / Pa**	0.8 / 2700	1.6 / 11900
3.7	**Air flow with an external static pressure differential of**		**m³/h / Pa**	2500 / 20	
3.8	**Refrigerant; total filling weight**		**type / kg**	R404A / 1.9	
3.9	**Max. output of electric heating element (2nd heat generator)**		**kW**	6.0	
4	**Dimensions, connections and weight**				
4.1	**Device dimensions**		**H x W x L cm**	125 x 75 x 68	
4.2	**Device connections to heating system**		**Inch**	Thread 1" external	
4.3	**Air duct inlet and outlet (min. internal dimensions)**		**L x W cm**	44 x 44	
4.4	**Weight of the transportable unit(s) incl. packing**		**kg**	177	
5	**Electrical connection**				
5.1	**Nominal voltage; fuse protection**		**V / A**	400 / 25	
5.2	**Nominal power consumption [1] A2 W35**		**kW**	2.27	2.33
5.3	**Starting current with soft starter**		**A**	19,5	
5.4	**Nominal current A2 W35 / cosφ**		**A / ---**	4.1 / 0.8	4.2 / 0.8
6	**Complies with the European safety regulations**			[2]	
7	**Additional model features**				
7.1	**Defrosting**			Automatic	
	Type of defrosting			Reverse circulation	
	Defrosting tray included			Yes (heated)	
7.2	**Heating water in device protected against icing [3]**			Yes	
7.3	**Performance levels**			1	
7.4	**Controller internal/external**			Internal	

1. This data indicates the size and capacity of the system according to EN 255 or EN 14511. For an analysis of the economic and energy efficiency of the system, other parameters, particularly the defrosting capacity, the bivalence point and regulation, should also be taken into consideration. The specified values, e.g. A2 / W55, have the following meaning: 2 °C external air temperature and 55 °C heating water flow temperature.
2. See CE declaration of conformity
3. The heat circulating pump and the heat pump controller must always be ready for operation.

2.6.3 Low-temperature Heat Pumps with Horizontal Air Circuit LI 11TE to LI 16TE

Device information for air-to-water heat pumps for heating purposes								
1	**Type and order code**			LI 11TE		LI 16TE		
2	**Design**							
2.1	**Degree of protection according to EN 60 529 for compact devices and heating components**			IP21		IP21		
2.2	**Installation location**			Indoors		Indoors		
3	**Performance data**							
3.1	**Operating temperature limits:**							
	Heating water flow/return flow		**°C / °C**	up to 58 / above 18		up to 58 / above 18		
	Air		**°C**	-25 to +35		-25 to +35		
3.2	**Temperature spread of heating water (flow/return flow) at A7 / W35K**			9.7	5.0	9.5	5.0	
3.3	**Heat output / COP**	**at A-7 / W35 [1]**	**kW / ---**	7.1 / 2.9	6.6 / 2.7	9.8 / 2.6	9.7 / 2.5	
		at A-7 / W45 [1]	**kW / ---**		6.4 / 2.3		9.0 / 2.1	
		at A2 / W35 [1]	**kW / ---**	8.8 / 3.2	8.8 / 3.1	12.2 / 3.2	12.1 / 3.1	
		at A7 / W35 [1]	**kW / ---**	11.3 / 3.8	11.3 / 3.6	15.4 / 3.7	15.1 / 3.6	
		at A7 / W45 [1]	**kW / ---**		9.6 / 3.1		14.8 / 3.0	
		at A10 / W35 [1]	**kW / ---**	12.2 / 4,1	12.1 / 3,9	16.1 / 3.8	15.9 / 3.6	
3.4	**Sound power level device / outdoors**		**dB(A)**	55 / 61		57 / 62		
3.5	**Sound pressure level at a distance of 1 m (indoors)**		**dB(A)**	50		52		
3.6	**Heating water flow with an internal pressure differential of**		**m³/h / Pa**	1.0 / 3000	1.9 / 10900	1.4 / 4500	2.6 / 14600	
3.7	**Air flow with an external static pressure differential of**		**m³/h / Pa**	4200 / 0		5200 / 0		
			m³/h / Pa	2500 / 25		4000 / 25		
3.8	**Refrigerant; total filling weight**		**type / kg**	R404A / 2.5		R404A / 3.1		
3.9	**Max. output of electric heating element (2nd heat generator) kW**			6,0		6,0		
4	**Dimensions, connections and weight**							
4.1	**Device dimensions**		**H x W x L cm**	136 x 75 x 88		157 x 75 x 88		
4.2	**Device connections to heating system**		**Inch**	Thread 1 1/4" external		Thread 1 1/4" external		
4.3	**Air duct inlet and outlet (min. internal dimensions)**		**L x W cm**	50 x 50		57 x 57		
4.4	**Weight of the transportable unit(s) incl. packing**		**kg**	200		235		
5	**Electrical connection**							
5.1	**Nominal voltage; fuse protection**		**V / A**	400 / 25		400 / 32		
5.2	**Nominal power consumption [1] A2 W35**		**kW**	2.74	2.86	3.81	3.91	
5.3	**Starting current with soft starter**		**A**	23		25		
5.4	**Nominal current A2 W35 / cosφ**		**A / ---**	4.94 / 0.8	5.16 / 0.8	6.9 / 0.8	7.1 / 0.8	
6	**Complies with the European safety regulations**			[2]		[2]		
7	**Additional model features**							
7.1	**Defrosting**			Automatic		Automatic		
	Type of defrosting			Reverse circulation		Reverse circulation		
	Defrosting tray included			Yes (heated)		Yes (heated)		
7.2	**Heating water in device protected against icing [3]**			Yes		Yes		
7.3	**Performance levels**			1		1		
7.4	**Controller internal/external**			Internal		Internal		

1. This data indicates the size and capacity of the system according to EN 255 or EN 14511. For an analysis of the economic and energy efficiency of the system, other parameters, particularly the defrosting capacity, the bivalence point and regulation, should also be taken into consideration. The specified values, e.g. A2 / W55, have the following meaning: 2 °C external air temperature and 55 °C heating water flow temperature.
2. See CE declaration of conformity
3. The heat circulating pump and the heat pump controller must always be ready for operation.

2.6.4 Low-temperature heat pumps with 2 compressors LI 20TE to LI 28TE

Device information for air-to-water heat pumps for heating purposes											
1	**Type and order code**				LI 20TE		LI 24TE		LI 28TE	
2	**Design**									
2.1	**Degree of protection according to EN 60 529 for compact devices and heating components**				IP21		IP21		IP21	
2.2	**Installation location**				Indoors		Indoors		Indoors	
3	**Performance data**									
3.1	**Operating temperature limits:**									
	Heating water flow/return flow [1]		**°C / °C**		up to 58 / above 18		up to 58 / above 18		up to 58 / above 18	
	Air		**°C**		-25 to +35		-25 to +35		-25 to +35	
3.2	**Temperature spread of heating water (flow/return flow) at A7 / W35K**				9.8	5.0	9.7	5.0	9.9	5.0
3.3	**Heat output / COP**	**at A-7 / W35** [2]	**kW / ---**	[3]	7.1 / 2.8	6.7 / 2.6	8.9 / 2.6	8.8 / 2.5	9.9 / 2.4	9.2 / 2.3
				[4]	12.7 / 2.8	11.7 / 2.6	16.1 / 2.7	15.5 / 2.4	19.1 / 2.7	16.1 / 2.3
		at A7 / W45 [2]	**kW / ---**	[3]		6.2 / 2.3		8.4 / 2.2		8.7 / 2.0
				[4]		11.1 / 2.2		14.4 / 2.1		15.0 / 1.9
		at A2 / W35 [2]	**kW / ---**	[3]	9.3 / 3.2	8.6 / 3.1	10.9 / 3.0	10.5 / 3.0	12.8 / 3.0	12.6 / 3.0
				[4]	14.9 / 3.1	14.6 / 3.0	19.2 / 3.2	18.7 / 3.1	22.3 / 3.0	22.2 / 3.0
		at A7 / W35 [2]	**kW / ---**	[3]	10.7 / 3.7	10.4 / 3.5	13.1 / 3.4	12.6 / 3.3	14.2 / 3.1	13.9 / 3.1
				[4]	17.1 / 3.5	17.0 / 3.4	24.8 / 3.6	24.2 / 3.4	25.8 / 3.4	25.1 / 3.3
		at A7 / W45 [2]	**kW / ---**	[3]		10.1 / 3.0		12.1 / 2.9		12.8 / 2.9
				[4]		16.6 / 2.9		23.7 / 2.9		24.6 / 2.8
		at A10 / W35 [2]	**kW / ---**	[3]	12.8 / 4.0	12.6 / 3.8	14.1 / 3.5	13.8 / 3.4	14.7 / 3.1	14.3 / 3.2
				[4]	20.0 / 3.8	19.5 / 3.7	26.6 / 3.8	25.4 / 3.6	29.1 / 3.6	28.7 / 3.5
3.4	**Sound power level device / outdoors**		**dB(A)**		58 / 64		62 / 68		62 / 68	
3.5	**Sound pressure level at a distance of 1 m (indoors)**		**dB(A)**		54		58		58	
3.6	**Heating water flow with an internal pressure differential of**		**m³/h / Pa**		1.8 / 3700	3.3 / 12300	2.3 / 5900	4.5 / 22700	2.3 / 3100	4.6 / 12000
3.7	**Air flow with an external static pressure differential of**		**m³/h / Pa**		6600 / 0		9000 / 0		9000 / 0	
			m³/h / Pa		5500 / 25		8000 / 25		8000 / 25	
3.8	**Refrigerant; total filling weight**		**type / kg**		R404A / 3.7		R404A / 4.2		R404A / 4.3	
4	**Dimensions, connections and weight**									
4.1	**Device dimensions**		**H x W x L cm**		157 x 75 x 88		171 x 75 x 103		171 x 75 x 103	
4.2	**Device connections to heating system**		**Inch**		Thread 1 1/4" external		Thread 1 1/4" external		Thread 1 1/4" external	
4.3	**Air duct inlet and outlet (min. internal dimensions)**		**L x W cm**		65 x 65		72.5 x 72.5		72.5 x 72.5	
4.4	**Weight of the transportable unit(s) incl. packing**		**kg**		255		310		314	
5	**Electrical connection**									
5.1	**Nominal voltage; fuse protection**		**V / A**		400 / 20 T		400 / 25 T		400 / 25 T	
5.2	**Nominal power consumption** [2] **A2 W35**		**kW**		4.80	4.89	6.05	6.11	7.40	7.44
5.3	**Starting current with soft starter**		**A**		23		24		25	
5.4	**Nominal current A2 W35 / cosφ**		**A / ---**		8.7 / 0.8	8.8 / 0.8	10.9 / 0.8	11.0 / 0.8	13.4 / 0.8	13.4 / 0.8
6	**Complies with the European safety regulations**				[5]		[5]		[5]	
7	**Additional model features**									
7.1	**Defrosting**				Automatic		Automatic		Automatic	
	Type of defrosting				Reverse circulation		Reverse circulation		Reverse circulation	
	Defrosting tray included				Yes (heated)		Yes (heated)		Yes (heated)	
7.2	**Heating water in device protected against icing** [6]				Yes		Yes		Yes	
7.3	**Performance levels**				2		2		2	
7.4	**Controller internal/external**				Internal		Internal		Internal	

1. See operating limits diagram
2. This data indicates the size and capacity of the system according to EN 255 or EN 14511. For an analysis of the economic and energy efficiency of the system, other parameters, particularly the defrosting capacity, the bivalence point and regulation, should also be taken into consideration. The specified values, e.g. A2 / W55, have the following meaning: 2 °C external air temperature and 55 °C heating water flow temperature.
3. Operation with 1 compressors
4. Operation with 2 compressors
5. See CE declaration of conformity
6. The heat circulating pump and the heat pump controller must always be ready for operation.

2.6.5 High-temperature heat pumps with 2 compressors LIH 22TE to LIH 26TE

Device information for air-to-water heat pumps for heating purposes							
1	**Type and order code**			LIH 22TE		LIH 26TE	
2	**Design**						
2.1	**Degree of protection according to EN 60 529 for compact devices and heating components**			IP21		IP21	
2.2	**Installation location**			Indoors		Indoors	
3	**Performance data**						
3.1	**Operating temperature limits:**						
	Heating water flow/return flow [1]		°C / °C	up to 75 / above 18		up to 75 / above 18	
	Air		°C	-25 to +35		-25 to +35	
3.2	**Temperature spread of heating water at A2 / W35**			7.1	5.0	8.4	5.0
3.3	**Heat output / COP**	**at A-7 / W35** [2]	kW / ---	11.0 / 2.6	11.0 / 2.3	13.0 / 2.8	12.9 / 2.6
		at A2 / W35 [2]	kW / ---	13.6 / 3.1	13.5 / 3.0	15.9 / 3.2	15.7 / 3.0
		at A-7 / W75 [2]	kW / ---	16.1 / 1.7	16.0 / 1.6	18.1 / 1.8	18.0 / 1.7
		at A7 / W35 [2]	kW / ---	15.4 / 3.4	15.2 / 3.2	19.8 / 3.8	19.5 / 3.6
		at A10 / W35 [2]	kW / ---	16.5 / 3.5	16.3 / 3.3	20.4 / 3.9	20.2 / 3.7
3.4	**Sound power level device / outdoors**		dB(A)	62 / 68		62 / 68	
3.5	**Sound pressure level at a distance of 1 m (indoors)**		dB(A	58		58	
3.6	**Heating water flow with an internal pressure differential of**		m³/h / Pa	1.8 / 3700	2.3 / 6000	1.8 / 3700	2.7 / 8200
3.7	**Air flow with an external static pressure differential of**		m³/h / Pa	9000 / 0		9000 / 0	
			m³/h / Pa	8000 / 25		8000 / 25	
3.8	**Refrigerant; total filling weight**		type / kg	R404A / 3.3		R404A / 3.7	
				R134a / 2.7		R134a / 3.1	
4	**Dimensions, connections and weight**						
4.1	**Device dimensions**		H x W x L cm	171 x 75 x 103		171 x 75 x 103	
4.2	**Device connections to heating system**		Inch	Thread 1 1/4" external		Thread 1 1/4" external	
4.3	**Air duct inlet and outlet (min. internal dimensions)**		L x W cm	72.5 x 72.5		72.5 x 72.5	
4.4	**Weight of the transportable unit(s) incl. packing**		kg	370		377	
5	**Electrical connection**						
5.1	**Nominal voltage; fuse protection**		V / A	400 / 25 T		400 / 25 T	
5.2	**Nominal power consumption** [2]	**A2 W35**	kW	4.4	4.48	5.0	5.16
5.3	**Starting current with soft starter**		A	25		30	
5.4	**Nominal current A2 W35 / cosφ**		A / ---	8.0 / 0.8	8.1 / 0.8	9.0 / 0.8	9.3 / 0.8
6	**Complies with the European safety regulations**			[3]		[3]	
7	**Additional model features**						
7.1	**Defrosting**			Automatic		Automatic	
	Type of defrosting			Reverse circulation		Reverse circulation	
	Defrosting tray included			Yes (heated)		Yes (heated)	
7.2	**Heating water in device protected against icing** [4]			Yes		Yes	
7.3	**Performance levels**			2		2	
7.4	**Controller internal/external**			External		External	

1. See operating limits diagram
2. This data indicates the size and capacity of the system according to EN 255 or EN 14511. For an analysis of the economic and energy efficiency of the system, other parameters, such as, in particular, the defrosting capacity, the bivalence point and regulation, should also be taken into consideration. The specified values, e.g. A2 / W55, have the following meaning: 2 °C external air temperature and 55 °C heating water flow temperature.
3. See CE declaration of conformity
4. The heat circulating pump and the heat pump controller must always be ready for operation.

2.7 Device Information for Air-to-Water Heat Pumps for Outdoor Installation (1-phase, 230 V AC)

2.7.1 Low-temperature heat pumps LA 11MS to LA 16MS

Device information for air-to-water heat pumps for heating purposes					
1	**Type and order code**			LA 11MS	LA 16MS
2	**Design**				
2.1	**Degree of protection according to EN 60 529 for compact devices and heating components**			IP24	IP24
2.2	**Installation location**			Outdoors	Outdoors
3	**Performance data**				
3.1	**Operating temperature limits:**				
	Heating water flow/return flow [1]		**°C / °C**	up to 55 / above 18	up to 55 / above 18
	Air		**°C**	-20 to +35	-20 to +35
3.2	**Temperature spread of heating water at A2 / W35**			7.8	7.8
	Heat output / COP	**at A-7 / W35 [2]**	**kW / ---**	7.6 / 2.9	9.8 / 2.6
		at A2 / W35 [2]	**kW / ---**	9.1 / 3.4	12.7 / 3.2
		at A2 / W50 [2]	**kW / ---**	9.0 / 2.5	12.2 / 2.4
		at A7 / W35 [2]	**kW / ---**	10.9 / 4.1	15.4 / 3.7
		at A10 / W35 [2]	**kW / ---**	12.0 / 4.6	16.1 / 3.8
3.3	**Sound power level**		**dB(A)**	63	64
3.4	**Sound pressure level at a distance of 10 m (air outlet side)**		**dB(A)**	33	34
3.5	**Heating water flow with an internal pressure differential of**		**m³/h / Pa**	1.0 / 3000	1.4 / 4500
3.6	**Air flow**		**m³/h / Pa**	2500	4000
3.7	**Refrigerant; total filling weight**		**type / kg**	R404A / 2.5	R404A / 3.1
4	**Dimensions, connections and weight**				
4.1	**Device dimensions**		**H x W x L cm**	136 x 136 x 85	157 x 155 x 85
4.2	**Device connections to heating system**		**Inch**	Thread 1" external	Thread 1" external
4.3	**Weight of the transportable unit(s) incl. packing**		**kg**	219	264
5	**Electrical connection**				
5.1	**Nominal voltage; fuse protection**		**V / A**	230 / 25	230 / 32
5.2	**Nominal power consumption [2]**	**A2 W35**	**kW**	2.65	3.95
5.3	**Starting current with soft starter**		**A**	38	45
5.4	**Nominal current A2 W35 / cosφ**		**A / ---**	14.4 / 0.8	21.5
6	**Complies with the European safety regulations**			[3]	[3]
7	**Additional model features**				
7.1	**Defrosting**			Automatic	Automatic
	Type of defrosting			Reverse circulation	Reverse circulation
	Defrosting tray included			Yes (heated)	Yes (heated)
7.2	**Heating water in device protected against icing [4]**			Yes	Yes
7.3	**Performance levels**			1	1
7.4	**Controller internal/external**			External	External

1. See operating limits diagram
2. This data indicates the size and capacity of the system according to EN 255 or EN 14511. For an analysis of the economic and energy efficiency of the system, other parameters, such as, in particular, the defrosting capacity, the bivalence point and regulation, should also be taken into consideration. The specified values, e.g. A2 / W55, have the following meaning: external air temperature 2 °C and heating water flow temperature 55 °C.
3. See CE declaration of conformity
4. The heat circulating pump and the heat pump controller must always be ready for operation.

2.8 Device Information for Air-to-Water Heat Pumps for Outdoor Installation (3-phase, 400 V AC)

2.8.1 Low-temperature heat pumps LA 8AS to LA 16AS

Device information for air-to-water heat pumps for heating purposes						
1	**Type and order code**			LA 8AS	LA 11AS	LA 16AS
2	**Design**					
2.1	**Degree of protection according to EN 60 529 for compact devices and heating components**			IP24	IP24	IP24
2.2	**Installation location**			Outdoors	Outdoors	Outdoors
3	**Performance data**					
3.1	**Operating temperature limits:**					
3.2	**Heating water flow/return flow** [1]		**°C / °C**	up to 55 / above 18	up to 55 / above 18	up to 55 / above 18
3.3	**Air**		**°C**	-25 to +35	-25 to +35	-25 to +35
3.4	**Temperature spread of heating water (flow/return flow) at A2 / W35**			7.1	7.5	7.5
3.5	**Heat output / COP**	**at A-7 / W35** [2]	**kW / ---**	5.1 / 2.5	7.1 / 2.9	9.8 / 2.6
		at A2 / W35 [2]	**kW / ---**	6.6 / 3.1	8.8 / 3.2	12.2 / 3.2
		at A2 / W50 [2]	**kW / ---**	6.2 / 2.4	8.5 / 2.5	11.5 / 2.4
		at A7 / W35 [2]	**kW / ---**	8.3 / 3.7	11.3 / 3.8	15.4 / 3.7
		at A10 / W35 [2]	**kW / ---**	8.8 / 3.8	12.2 / 4.1	16.1 / 3.8
3.6	**Sound power level**		**dB(A)**	62	63	64
3.7	**Sound pressure level at a distance of 10 m (air outlet side)**		**dB(A)**	32	33	34
3.8	**Heating water flow with an internal pressure differential of**		**m³/h / Pa**	0.8 / 2700	1.0 / 3000	1.4 / 4500
3.9	**Air flow**		**m³/h / Pa**	2500	2500	4000
3.10	**Refrigerant; total filling weight**		**type / kg**	R404A / 1.9	R404A / 2.5	R404A / 3.1
4	**Dimensions, connections and weight**					
4.1	**Device dimensions**		**H x W x L cm**	128 x 75 x 65	136 x 136 x 85	157 x 155 x 85
4.2	**Device connections to heating system**		**Inch**	Thread 1" external	Thread 1" external	Thread 1" external
4.3	**Weight of the transportable unit(s) incl. packing**		**kg**	166	219	264
5	**Electrical connection**					
5.1	**Nominal voltage; fuse protection**		**V / A**	400 / 16	400 / 16	400 / 20
5.2	**Nominal power consumption** [2] **A2 W35**		**kW**	2.1	2.74	3.81
5.3	**Starting current with soft starter**		**A**	19.5	23	25
5.4	**Nominal current A2 W35 / cosφ**		**A / ---**	3.8 / 0.8	4.9 / 0.8	6.9 / 0.8
6	**Complies with the European safety regulations**			[3]	[3]	[3]
7	**Additional model features**					
7.1	**Defrosting**			Automatic	Automatic	Automatic
	Type of defrosting			Reverse circulation	Reverse circulation	Reverse circulation
	Defrosting tray included			Yes (heated)	Yes (heated)	Yes (heated)
7.2	**Heating water in device protected against icing** [4]			Yes	Yes	Yes
7.3	**Performance levels**			1	1	1
7.4	**Controller internal/external**			External	External	External

1. See operating limits diagram
2. This data indicates the size and capacity of the system according to EN 255 or EN 14511. For an analysis of the economic and energy efficiency of the system, other parameters, particularly the defrosting capacity, the bivalence point and regulation, should also be taken into consideration. The specified values, e.g. A2 / W55, have the following meaning: 2 °C external air temperature and 55 °C heating water flow temperature.
3. See CE declaration of conformity
4. The heat circulating pump and the heat pump controller must always be ready for operation.

2.8.2 Low-temperature heat pumps with 2 compressors LA 20AS to LA 28AS

Device information for air-to-water heat pumps for heating purposes							
1	**Type and order code**				LA 20AS	LA 24AS	LA 28AS
2	**Design**						
2.1	**Degree of protection according to EN 60 529 for compact devices and heating components**				IP24	IP24	IP24
2.2	**Installation location**				Outdoors	Outdoors	Outdoors
3	**Performance data**						
3.1	**Operating temperature limits:**						
	Heating water flow/return flow [1]		**°C / °C**		up to 55 / above 18	up to 55 / above 18	up to 55 / above 18
	Air		**°C**		-25 to +35	-25 to +35	-25 to +35
3.2	**Temperature spread of heating water (flow/return flow) at A2 / W35K**				7.9	8.4	9.4
3.3	**Heat output / COP**	**at A-7 / W35** [2]	**kW / ---**	[3]	7.0 / 2.5	8.9 / 2.6	9.9 / 2.4
				[4]	12.4 / 2.7	16.1 / 2.7	19.1 / 2.7
		at A2 / W35 [2]	**kW / ---**	[3]	9.3 / 3.1	10.9 / 3.0	12.8 / 3.0
				[4]	14.9 / 3.0	19.2 / 3.2	22.3 / 3.0
		at A2 / W50 [2]	**kW / ---**	[3]	8.5 / 2.4	9.9 / 2.3	10.8 / 2.0
				[4]	14.2 / 2.3	18.0 / 2.4	21.1 / 2.3
		at A7 / W35 [2]	**kW / ---**	[3]	9.8 / 3.2	13.1 / 3.4	14.2 / 3.1
				[4]	16.6 / 3.1	24.8 / 3.6	25.8 / 3.4
		at A10 / W35 [2]	**kW / ---**	[3]	10.3 / 3.3	14.1 / 3.5	14.7 / 3.1
				[4]	17.8 / 3.3	26.6 / 3.8	29.1 / 3.6
3.4	**Sound power level**		**dB(A)**		64	68	68
3.5	**Sound pressure level at a distance of 10 m (air outlet side)**		**dB(A)**		37	41	41
3.6	**Heating water flow with an internal pressure differential of**		**m³/h / Pa**		1.8 / 6500	2.3 / 5900	2.3 / 5900
3.7	**Air flow**		**m³/h**		5500	8000	8000
3.8	**Refrigerant; total filling weight**		**type / kg**		R404A / 3.7	R404A / 4.2	R404A / 4.2
4	**Dimensions, connections and weight**						
4.1	**Device dimensions**		**H x W x L cm**		157 x 155 x 85	171 x 168 x 100	171 x 168 x 100
4.2	**Device connections to heating system**		**Inch**		Thread 1 1/4" external	Thread 1 1/4" external	Thread1 1/4" external
4.3	**Weight of the transportable unit(s) incl. packing**		**kg**		284	351	355
5	**Electrical connection**						
5.1	**Nominal voltage; fuse protection**		**V / A**		400 / 20 T	400 / 25 T	400 / 25 T
5.2	**Nominal power consumption** [2] **A2 W35**		**kW**		4.9	6.1	7.4
5.3	**Starting current with soft starter**		**A**		23	24	25
5.4	**Nominal current A2 W35 / cosφ**		**A / ---**		8.8 / 0,8	10.9 / 0.8	13.4 / 0.8
6	**Complies with the European safety regulations**				[5]	[5]	[5]
7	**Additional model features**						
7.1	**Defrosting**				Automatic	Automatic	Automatic
	Type of defrosting				Reverse circulation	Reverse circulation	Reverse circulation
	Defrosting tray included				Yes (heated)	Yes (heated)	Yes (heated)
7.2	**Heating water in device protected against icing** [6]				Yes	Yes	Yes
7.3	**Performance levels**				2	2	2
7.4	**Controller internal/external**				External	External	External

1. See operating limits diagram
2. This data indicates the size and capacity of the system according to EN 255 or EN 14511. For an analysis of the economic and energy efficiency of the system, other parameters, particularly the defrosting capacity, the bivalence point and regulation, should also be taken into consideration. The specified values, e.g. A2 / W55, have the following meaning: 2 °C external air temperature and 55 °C heating water flow temperature.
3. Operation with 1 compressors
4. Operation with 2 compressors
5. See CE declaration of conformity
6. The heat circulating pump and the heat pump controller must always be ready for operation.

2.8.3 Medium-temperature heat pumps LA 9PS

Device information for air-to-water heat pumps for heating purposes				
1	**Type and order code**			LA 9PS
2	**Design**			
2.1	**Design**			Compact
2.2	**Degree of protection according to EN 60 529 for compact devices and heating components**			IP24
2.3	**Installation location**			Outdoors
3	**Performance data**			
3.1	**Operating temperature limits:**			
	Heating water flow/return flow [1]		**°C / °C**	up to 65 / above 18
	Air		**°C**	-25 to +35
3.2	**Temperature spread of heating water (flow/return flow) at A2 / W35K**			5.5
3.3	**Heat output / COP**	**at A-7 / W35** [2]	**kW / ---**	5.6 / 2.6
		at A-7 / W50 [2]	**kW / ---**	5.0 / 2.2
		at A2 / W35 [2]	**kW / ---**	7.1 / 3.2
		at A7 / W35 [2]	**kW / ---**	8.5 / 3.6
		at A10 / W35 [2]	**kW / ---**	9.6 / 4.0
3.4	**Sound power level**[3]		**dB(A)**	62
3.5	**Heating water flow with an internal pressure differential of**		**m³/h / Pa**	1.2 / 9000
3.6	**Air flow**		**m³/h / Pa**	2000
3.7	**Refrigerant; total filling weight**		**type / kg**	R290 / 1.0
4	**Dimensions, connections and weight**			
4.1	**Device dimensions**		**H x W x L cm**	132 x 77 x 66
4.2	**Device connections to heating system**		**Inch**	Thread 1" external
4.3	**Weight of the transportable unit(s) incl. packing**		**kg**	168
5	**Electrical connection**			
5.1	**Nominal voltage; fuse protection**		**V / A**	400 / 16
5.2	**Nominal power consumption** [2] **A2 W35**		**kW**	2.2
5.3	**Starting current with soft starter**		**A**	28
5.4	**Nominal current A2 W35 / cosφ**		**A / ---**	4.0 / 0.8
6	**Complies with the European safety regulations**			[4]
7	**Additional model features**			
7.1	**Defrosting**			Automatic
	Type of defrosting			Reverse circulation
	Defrosting tray included			Yes (heated)
7.2	**Heating water in device protected against icing** [5]			Yes
7.3	**Performance levels**			1
7.4	**Controller internal/external**			External

1. See operating limits diagram
2. This data indicates the size and capacity of the system according to EN 255 or EN 14511. For an analysis of the economic and energy efficiency of the system, other parameters, particularly the defrosting capacity, the bivalence point and regulation, should also be taken into consideration. The specified values, e.g. A2 / W55, have the following meaning: 2 °C external air temperature and 55 °C heating water flow temperature.
3. The directional sound pressure levels are decisive for the positioning of the installation.
4. See CE declaration of conformity
5. The heat circulating pump and the heat pump controller must always be ready for operation.

2.8.4 Medium-temperature heat pumps LA 11PS

Device information for air-to-water heat pumps for heating purposes					
1	**Type and order code**			LA 11PS	
2	**Design**				
2.1	**Degree of protection according to EN 60 529 for compact devices and heating components**			IP24	
2.2	**Installation location**			Outdoors	
3	**Performance data**				
3.1	**Operating temperature limits:**				
	Heating water flow/return flow		**°C / °C**	up to 65 / above 18	
	Air		**°C**	-25 to +35	
3.2	**Temperature spread of heating water (flow/return flow) at A7 / W35K**			9.2	5.0
3.3	**Heat output / COP**	**at A-7 / W35 [1]**	**kW / ---**	7.3 / 2.5	7.0 / 2.5
		at A-7 / W45 [2]	**kW / ---**		6,4 / 2,2
		at A2 / W35 [2]	**kW / ---**	9.2 / 3.1	8.7 / 3.0
		at A7 / W35 [2]	**kW / ---**	11.5 / 3.8	11.2 / 3.5
		at A7 / W45 [2]	**kW / ---**		10,5 / 3,0
		at A10 / W35 [2]	**kW / ---**	13.1 / 4.1	11.8 / 3.9
3.4	**Sound power level**		**dB(A)**	64	
3.5	**Sound pressure level at a distance of 10 m (air outlet side) dB(A)**			34	
3.6	**Heating water flow with an internal pressure differential of m³/h / Pa**			1.1 / 2600	2.1 / 9500
3.7	**Air flow**		**m³/h / Pa**	4000	
3.8	**Refrigerant; total filling weight**		**type / kg**	R290 / 1.5	
4	**Dimensions, connections and weight**				
4.1	**Device dimensions**		**H x W x L cm**	157 x 155 x 85	
4.2	**Device connections to heating system**		**Inch**	Thread 1" external	
4.3	**Weight of the transportable unit(s) incl. packing**		**kg**	259	
5	**Electrical connection**				
5.1	**Nominal voltage; fuse protection**		**V / A**	400 / 16	
5.2	**Nominal power consumption [2] A2 W35**		**kW**	2.98	2.9
5.3	**Starting current with soft starter**		**A**	30	
5.4	**Nominal current A2 W35 / cosφ**		**A / ---**	5.38	5.23
6	**Complies with the European safety regulations**			[2]	
7	**Additional model features**				
7.1	**Defrosting**			Automatic	
	Type of defrosting			Hot gas	
	Defrosting tray included			Yes (heated)	
7.2	**Heating water in device protected against icing [3]**			Yes	
7.3	**Performance levels**			1	
7.4	**Controller internal/external**			External	

1. This data indicates the size and capacity of the system according to 255 or EN14511. For an analysis of the economic and energy efficiency of the system, other parameters, in particular the defrosting capacity, the bivalence point and regulation, should also be taken into consideration. The specified values, e.g. A2 / W55, have the following meaning: 2 °C external air temperature and 55 °C heating water flow temperature.
2. See CE declaration of conformity
3. The heat circulating pump and the heat pump controller must always be ready for operation.

2.8.5 Medium-temperature heat pumps with 2 compressors LA 17PS to LA 26PS

Device information for air-to-water heat pumps for heating purposes												
1	**Type and order code**				LA 17PS		LA 22PS		LA 26PS	
2	**Design**									
2.1	**Degree of protection according to EN 60 529 for compact devices and heating components**				IP24		IP24		IP24	
2.2	**Installation location**				Outdoors		Outdoors		Outdoors	
3	**Performance data**									
3.1	**Operating temperature limits:**									
	Heating water flow/return flow [1]		°C / °C		up to 65 / above 18		up to 65 / above 18		up to 65 / above 18	
	Air		°C		-25 to +35		-25 to +35		-25 to +35	
3.2	**Temperature spread of heating water (flow/return flow) at A7 / W35K**				9.3	5.0	9.5		9.4	
3.3	**Heat output / COP**	**at A-7 / W35** [2]	**kW / ---**	[3]	6.7 / 2.5	6.4 / 2.4	7.7 / 2.4		8.7 / 2.4	
				[4]	11.4 / 2.6	10.8 / 2.5	13.6 / 2.6		14.4 / 2.6	
		at A-7 / W45 [2]	**kW / ---**	[3]		6.0 / 2.2				
				[4]		10.3 / 2.2				
		at A2 / W35 [2]	**kW / ---**	[3]	8.7 / 3.2	8.3 / 3.0	10.6 / 3.0		11.7 / 3.0	
				[4]	14.5 / 3,.	14.3 / 3.0	16.7 / 3.1		18.8 / 3.0	
		at A7 / W35 [2]	**kW / ---**	[3]	10.1 / 3.6	9.6 / 3.4	12.6 / 3.8		13.7 / 3.6	
				[4]	17.3 / 3.5	16.6 / 3.4	22.0 / 3.8		24.0 / 3.7	
		at A7 / W45 [2]	**kW / ---**	[3]		9.3 / 2.9				
				[4]		16.1 / 2.9				
		at A10 / W35 [2]	**kW / ---**	[3]	11.8 / 4.1	11.4 / 4.1	13.7 / 4.2		15.0 / 4.1	
				[4]	19.6 / 3.8	19.2 / 3.8	23.4 / 4.0		26.2 / 4.0	
3.4	**Sound power level**		**dB(A)**		64		68		68	
3.5	**Sound pressure level at a distance of 10 m (air outlet side)**		**dB(A)**		37		41		41	
3.6	**Heating water flow with an internal pressure differential of**		**m³/h / Pa**		1.6 / 2900	3.0 / 10000	2.0 / 4500		2.2 / 3100	
3.7	**Air flow**		**m³/h**		5500		8000		8000	
3.8	**Refrigerant; total filling weight**		**type / kg**		R290 / 1.8		R290 / 2.2		R290 / 2.5	
4	**Dimensions, connections and weight**									
4.1	**Device dimensions**		**H x W x L cm**		157 x 155 x 85		171 x 168 x 100		171 x 168 x 100	
4.2	**Device connections to heating system**		**Inch**		Thread 1 1/4" external		Thread 1 1/4" external		Thread 1 1/4" external	
4.3	**Weight of the transportable unit(s) incl. packing**		**kg**		330		360		371	
5	**Electrical connection**									
5.1	**Nominal voltage; fuse protection**		**V / A**		400 / 20 T		400 / 20 T		400 / 25 T	
5.2	**Nominal power consumption** [2] **A2 W35**		**kW**		4.74	4.76	5.4		6.2	
5.3	**Starting current with soft starter**		**A**		23		25		30	
5.4	**Nominal current A2 W35 / cosφ**		**A / ---**		8,6 / 0,8	8,6 / 0,8	9,8 / 0,8		11,2 / 0,8	
6	**Complies with the European safety regulations**				[5]		[5]		[5]	
7	**Additional model features**									
7.1	**Defrosting**				Automatic		Automatic		Automatic	
	Type of defrosting				Hot gas		Hot gas		Hot gas	
	Defrosting tray included				Yes (heated)		Yes (heated)		Yes (heated)	
7.2	**Heating water in device protected against icing** [6]				Yes		Yes		Yes	
7.3	**Performance levels**				2		2		2	
7.4	**Controller internal/external**				External		External		External	

1. See operating limits diagram
2. This data indicates the size and capacity of the system according to EN 255 or EN 14511. For an analysis of the economic and energy efficiency of the system, other parameters, in particular the defrosting capacity, the bivalence point and regulation, should also be taken into consideration. The specified values, e.g. A2 / W55, have the following meaning: 2 °C external air temperature and 55 °C heating water flow temperature.
3. Operation with 1 compressors
4. Operation with 2 compressors
5. See CE declaration of conformity
6. The heat circulating pump and the heat pump controller must always be ready for operation.

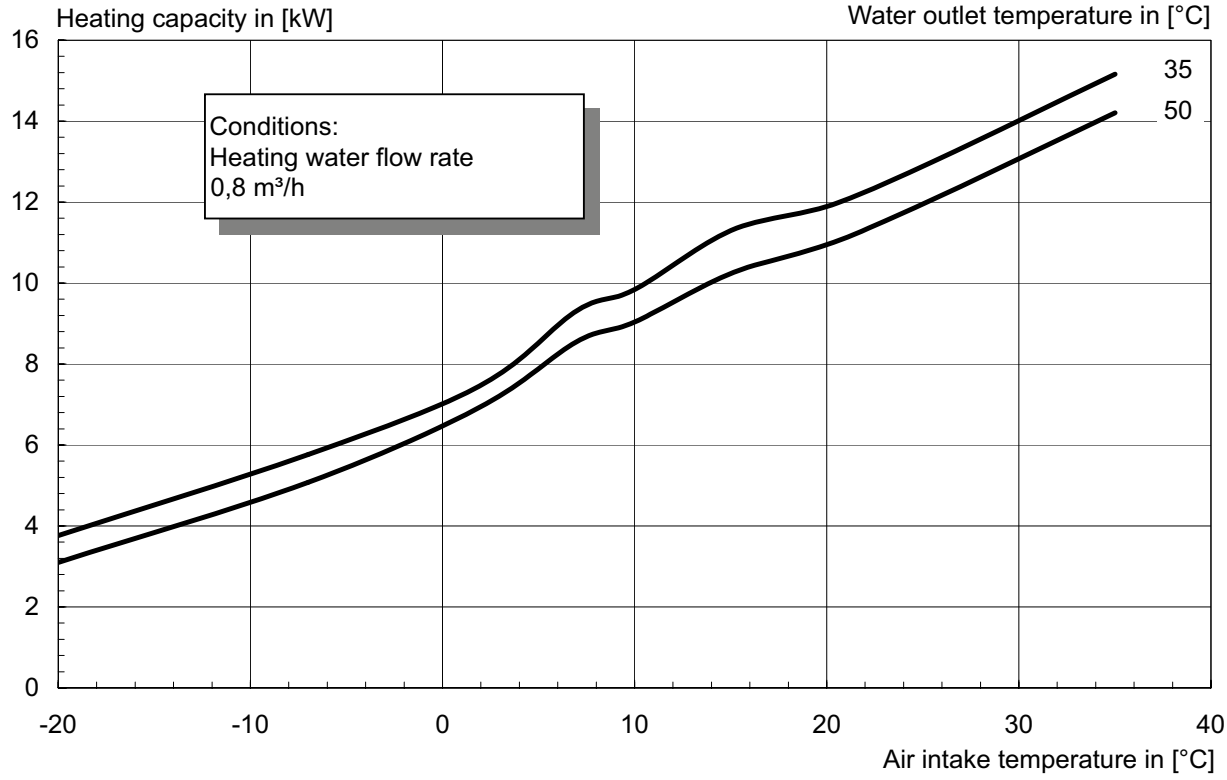
2.8.6 High-temperature heat pumps LA 22HS to LA 26HS

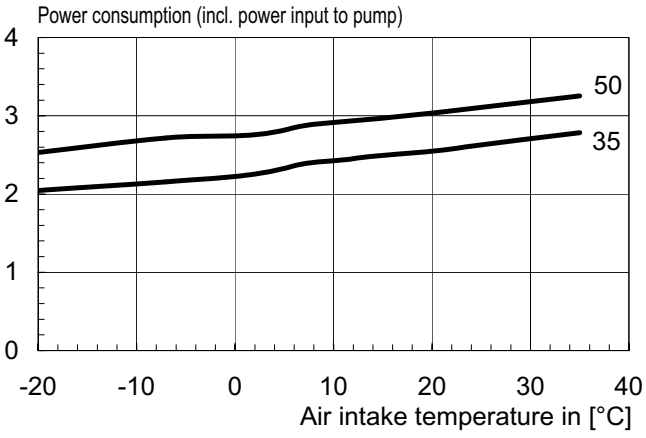
Device information for air-to-water heat pumps for heating purposes					
1	**Type and order code**			LA 22HS	LA 26HS
2	**Design**				
2.1	**Design**			Compact	Compact
2.2	**Degree of protection according to EN 60 529 for compact devices and heating components**			IP24	IP24
2.3	**Installation location**			Outdoors	Outdoors
3	**Performance data**				
3.1	**Operating temperature limits:**				
	Heating water flow/return flow [1]		**°C / °C**	up to 75 / above 18	up to 75 / above 18
	Air		**°C**	-25 to +35	-25 to +35
3.2	**Temperature spread of heating water (flow/return flow) at A2 / W35K**			7.1	8.4
3.3	**Heat output / COP**	**at A-7 / W35** [2]	**kW / ---**	11.0 / 2.6	13.0 / 2.8
		at A2 / W35 [2]	**kW / ---**	13.6 / 3.1	15.9 / 3.2
		at A-7 / W75 [2]	**kW / ---**	16.1 / 1.7	18.1 / 1.8
		at A7 / W35 [2]	**kW / ---**	15.4 / 3.4	19.8 / 3.8
		at A10 / W35 [2]	**kW / ---**	16.5 / 3.5	20.4 / 3.9
3.4	**Sound power level**		**dB(A)**	-	-
3.5	**Heating water flow with an internal pressure differential of**		**m³/h / Pa**	1.8 / 3000	1.8 / 3000
3.6	**Air flow**		**m³/h**	8000	8000
3.7	**Refrigerant; total filling weight**		**type / kg**	R404A / 3.3	R404A / 3.7
			Type / kg	R134a / 2.7	R134a / 3.1
4	**Dimensions, connections and weights**				
4.1	**Device dimensions**		**H x W x L cm**	171 x 168 x 100	171 x 168 x 100
4.2	**Device connections to heating system**		**Inch**	Thread 1 1/4" external	Thread 1 1/4" external
4.3	**Weight of the transportable unit(s) incl. packing**		**kg**	411	418
5	**Electrical connection**				
5.1	**Nominal voltage; fuse protection**		**V / A**	400 / 25 T	400 / 25 T
5.2	**Nominal power consumption** [2] **A2 W35**		**kW**	4.4	5,0
5.3	**Starting current with soft starter**		**A**	25	30
5.4	**Nominal current A2 W35 / cosφ**		**A / ---**	8.0 / 0.8	9.0 / 0.8
6	**Complies with the European safety regulations**			[3]	[3]
7	**Additional model features**				
7.1	**Defrosting**			Automatic	Automatic
	Type of defrosting			Reverse circulation	Reverse circulation
	Defrosting tray included			Yes (heated)	Yes (heated)
7.2	**Heating water in device protected against icing** [4]			Yes	Yes
7.3	**Performance levels**			2	2
7.4	**Controller internal/external**			External	External

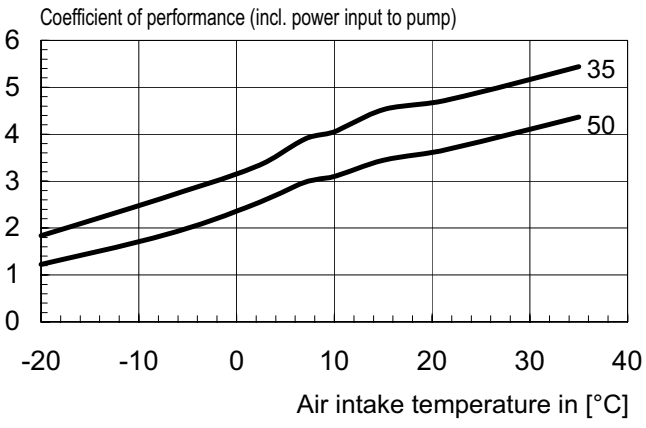
1. See operating limits diagram
2. This data indicates the size and capacity of the system according to EN 255 or EN 14511. For an analysis of the economic and energy efficiency of the system, other parameters, in particular the defrosting capacity, the bivalence point and regulation, should also be taken into consideration. The specified values, e.g. A2 / W55, have the following meaning: 2 °C external air temperature and 55 °C heating water flow temperature.
3. See CE declaration of conformity
4. The heat circulating pump and the heat pump controller must always be ready for operation.

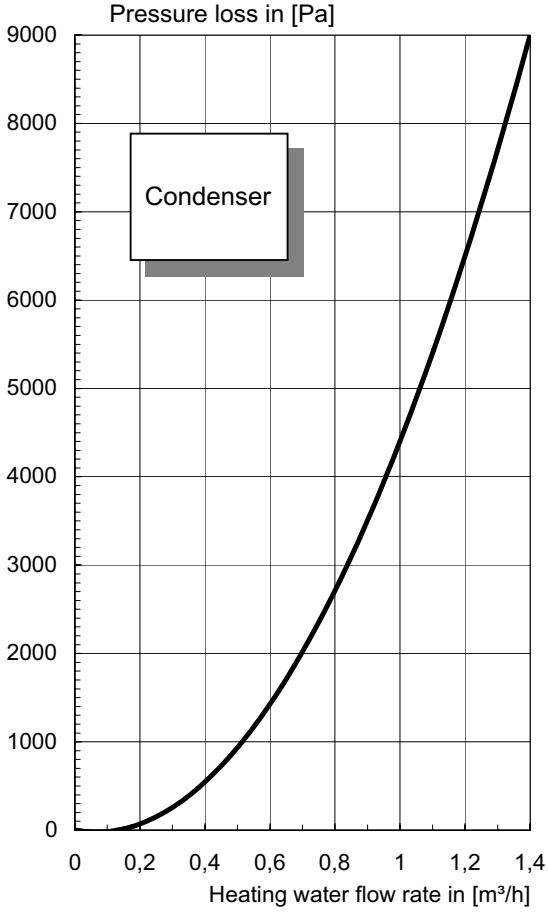
2.9 Characteristic Curves for Air-to-Water Heat Pumps (1-phase, 230 V AC)

2.9.1 Characteristic curves LIK 8ME

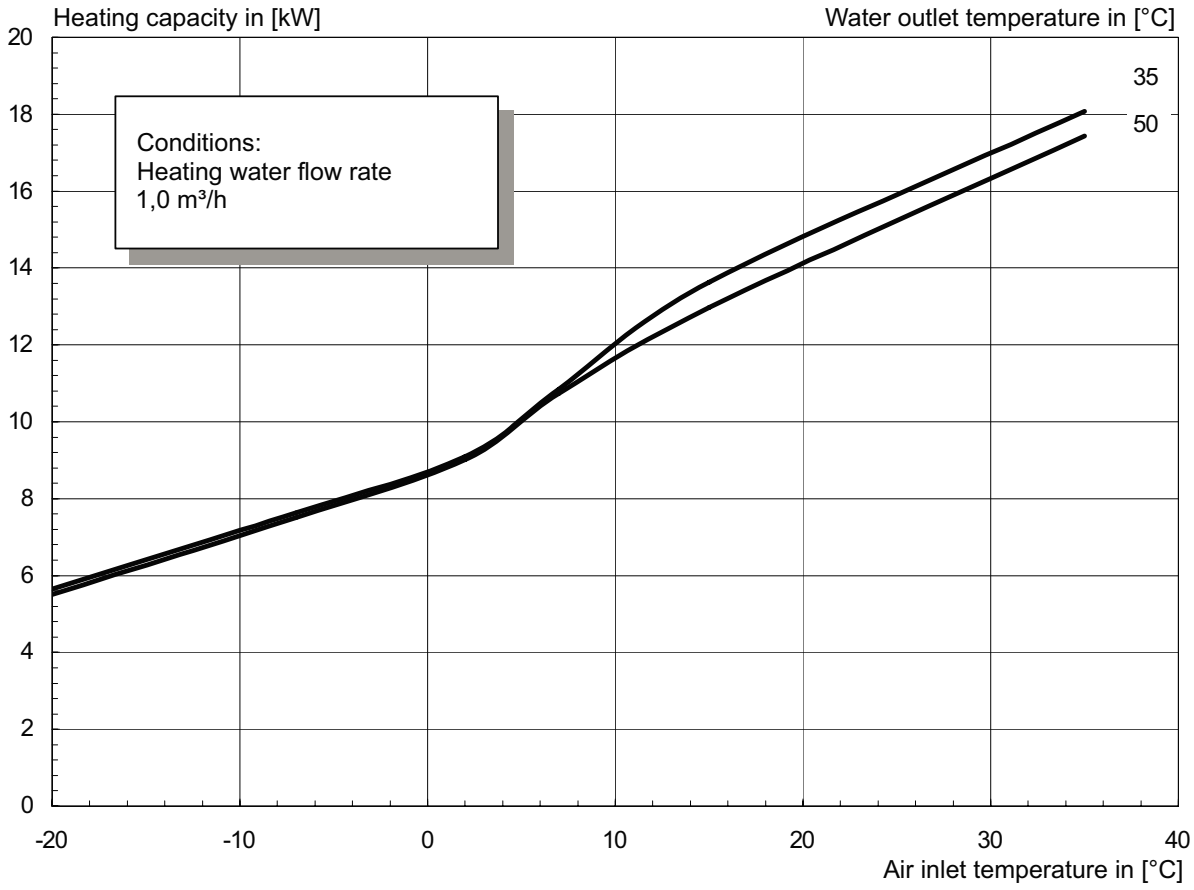


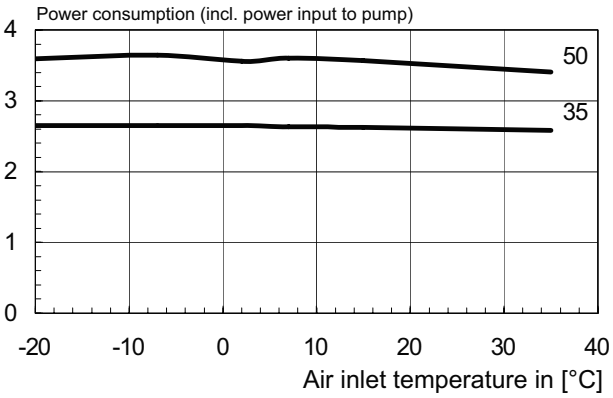


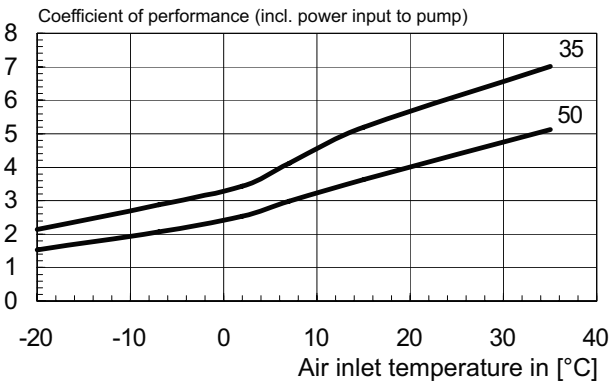


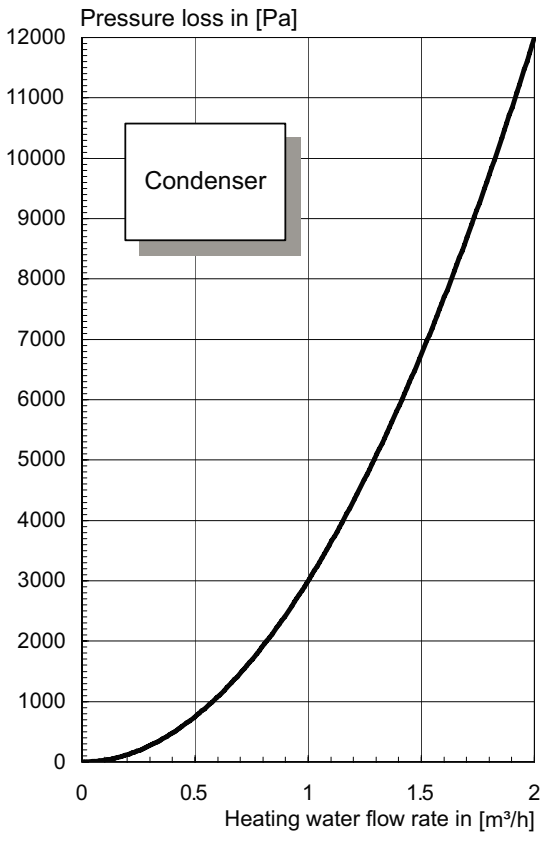


2.9.2 Characteristic curves LI 11ME / LA 11MS

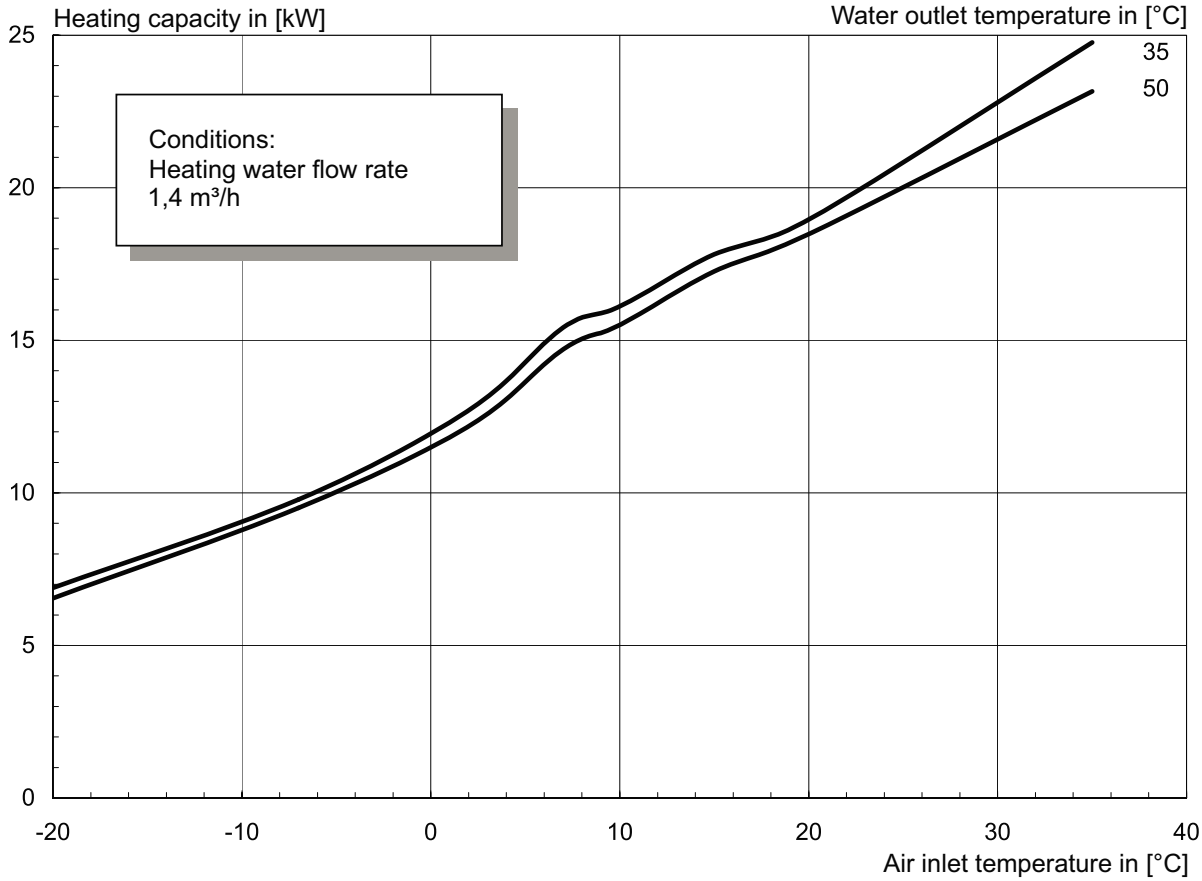


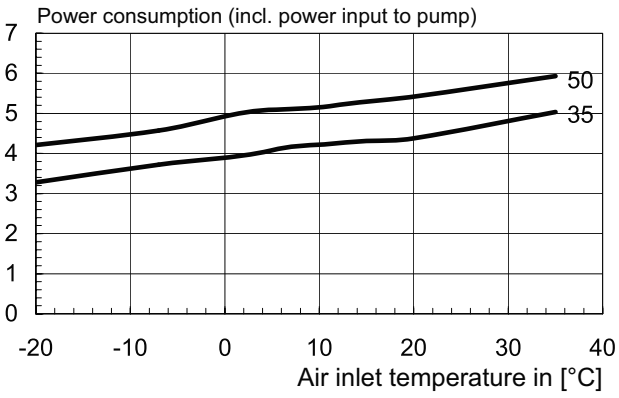


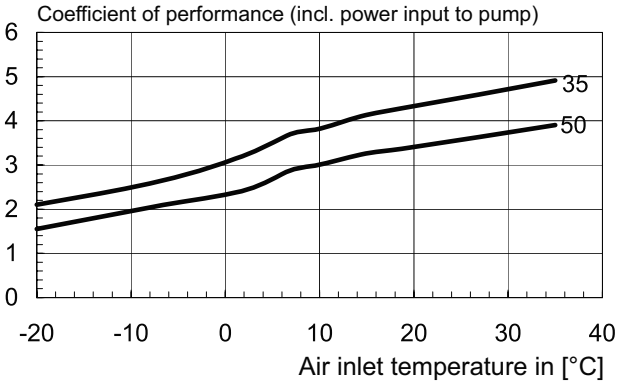


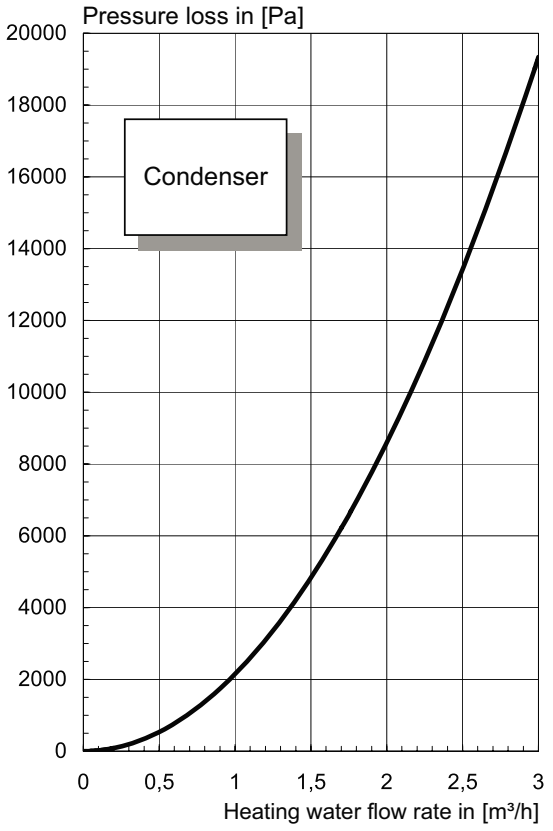


2.9.3 Characteristic curves LA 16MS



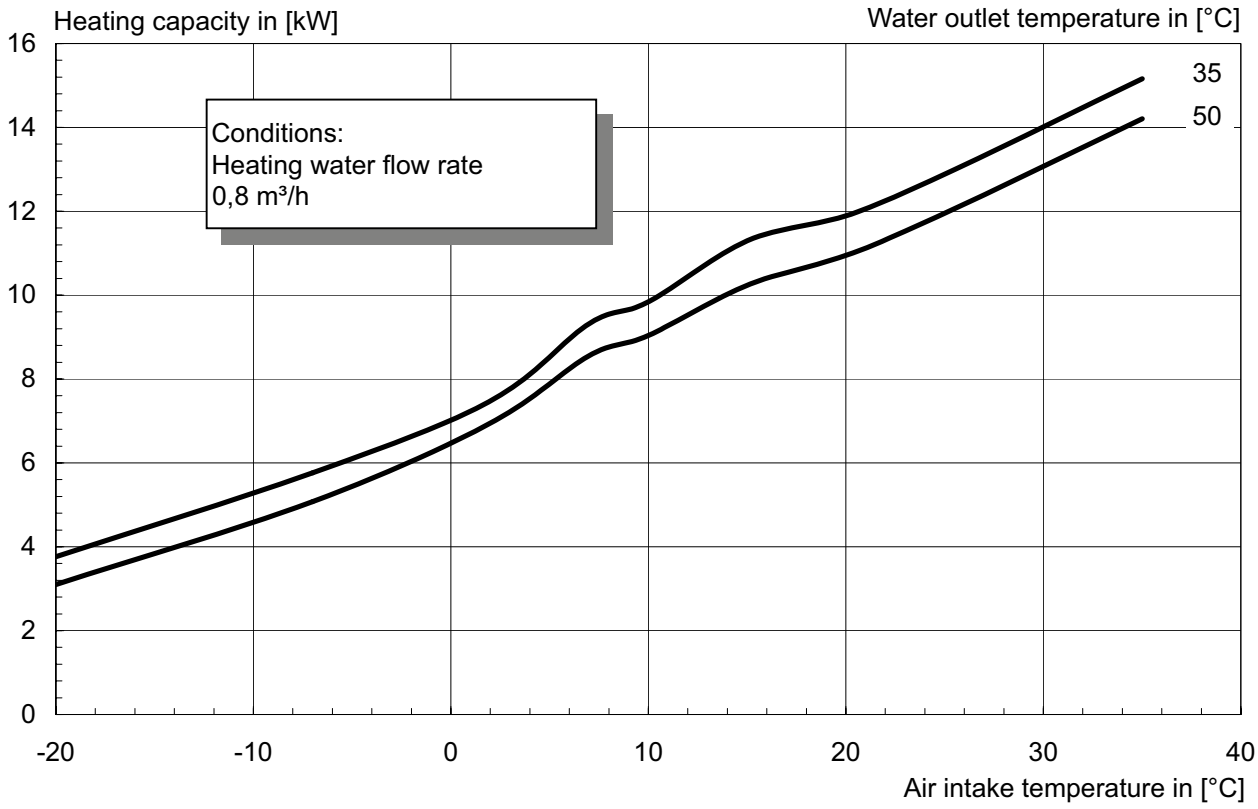


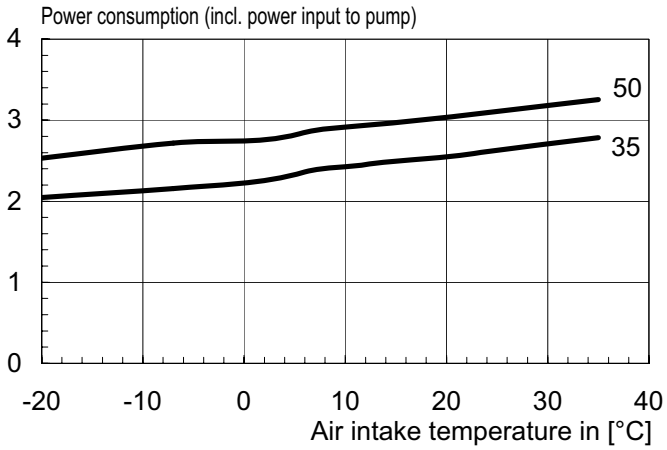


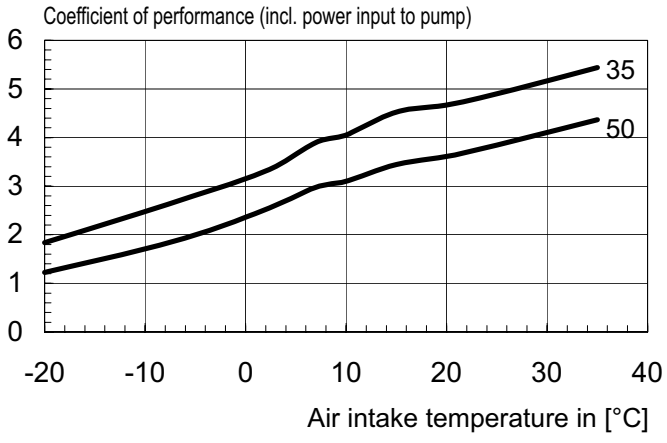


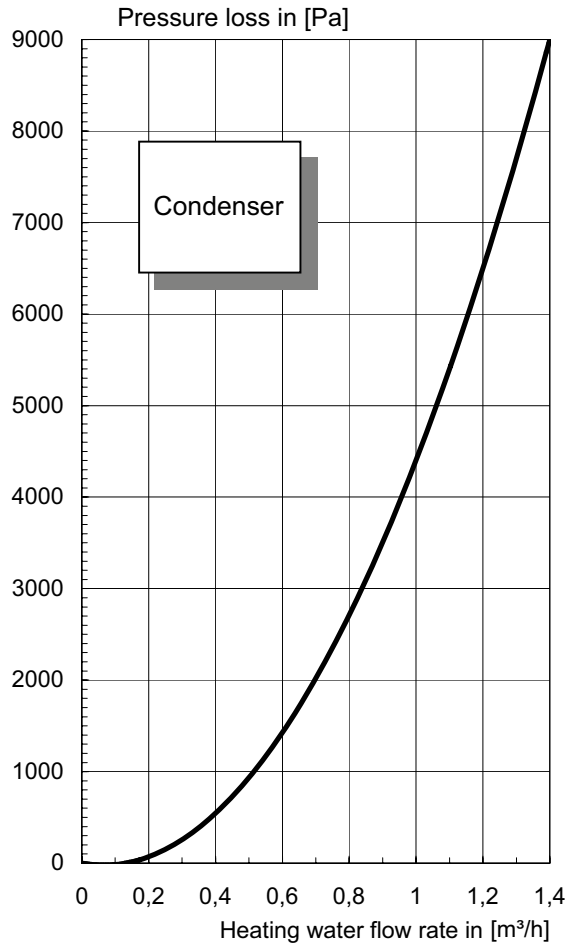
2.10 Characteristic Curves for Air-to-Water Heat Pumps (3-phase, 400 V AC)

2.10.1 Characteristic curves LIK 8TE / LI 9TE

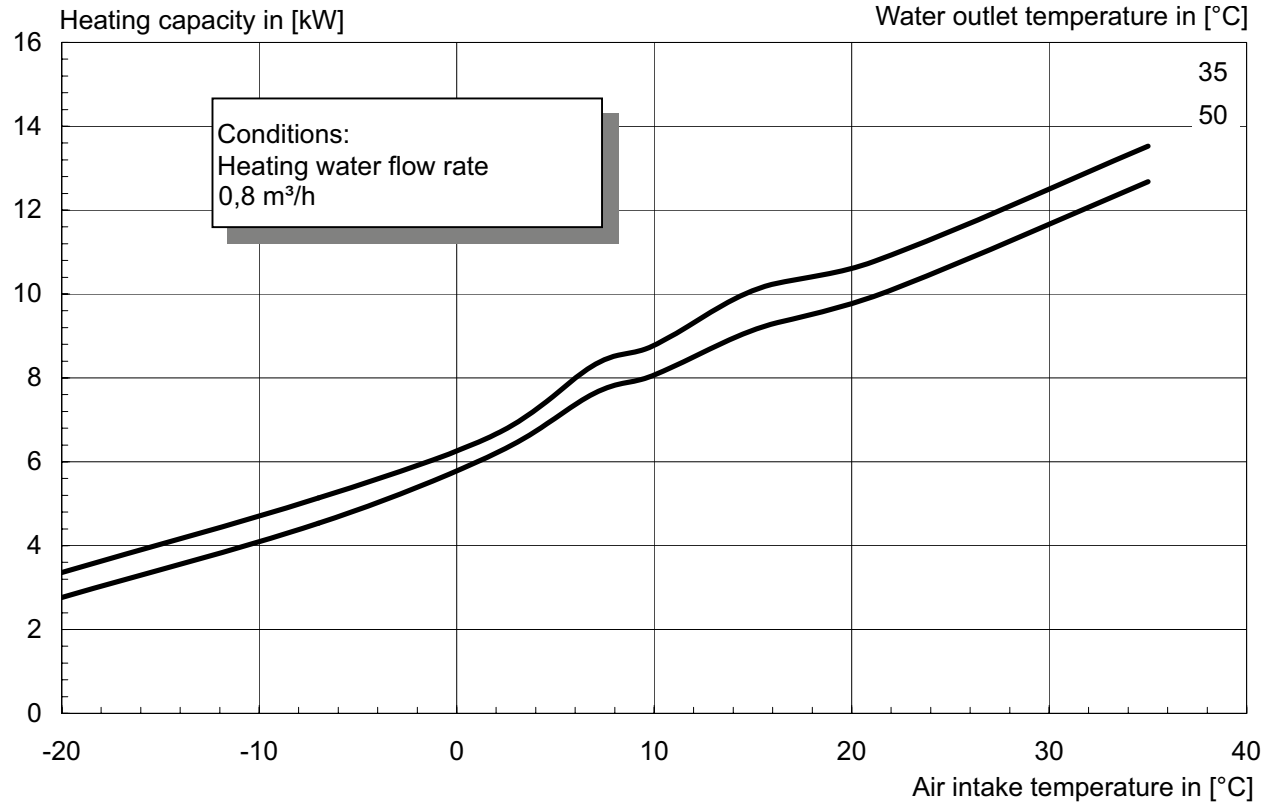


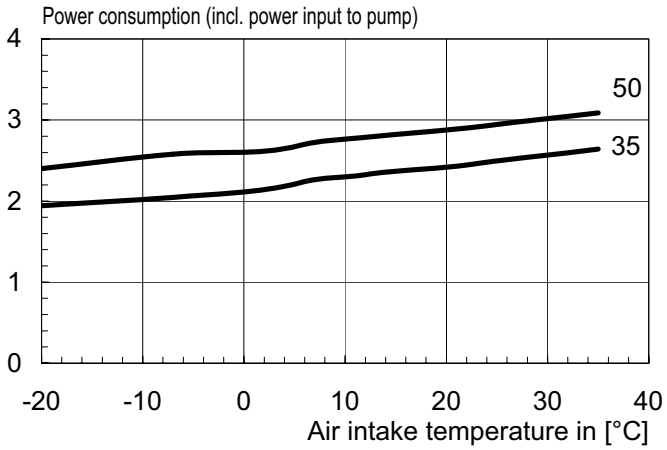


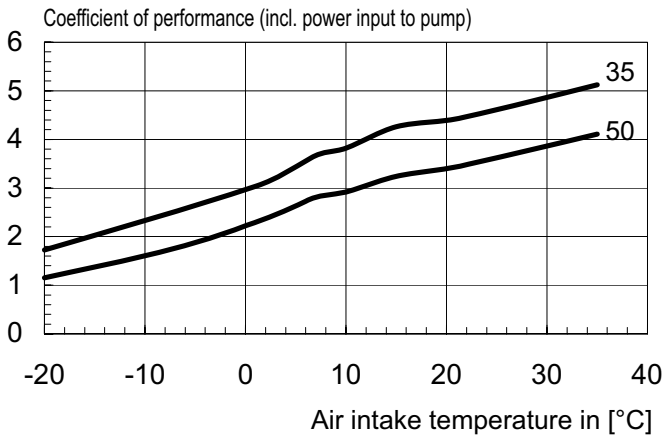


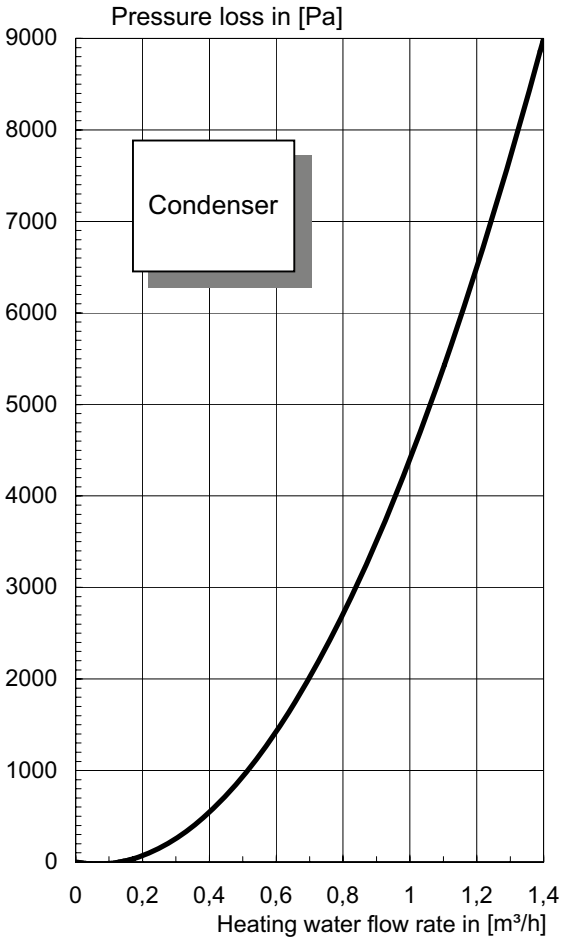


2.10.2 Characteristic curves LA 8AS

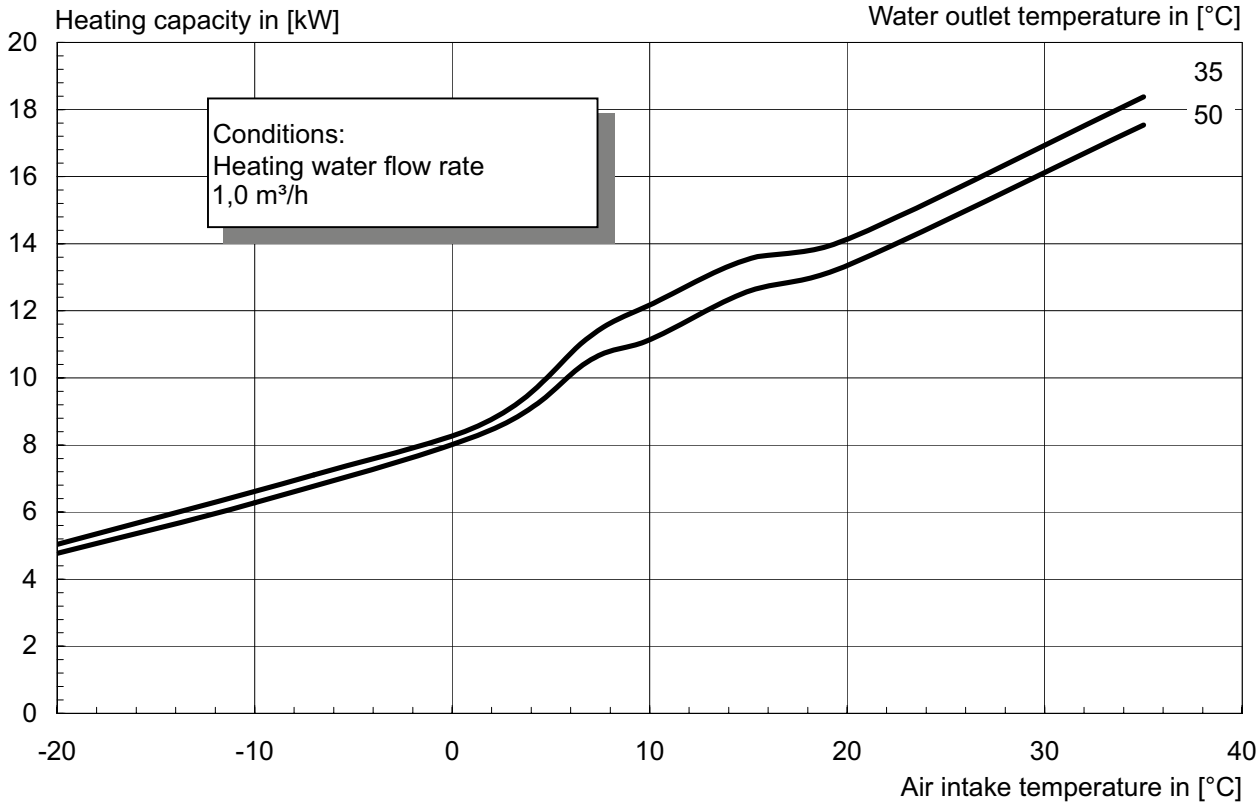


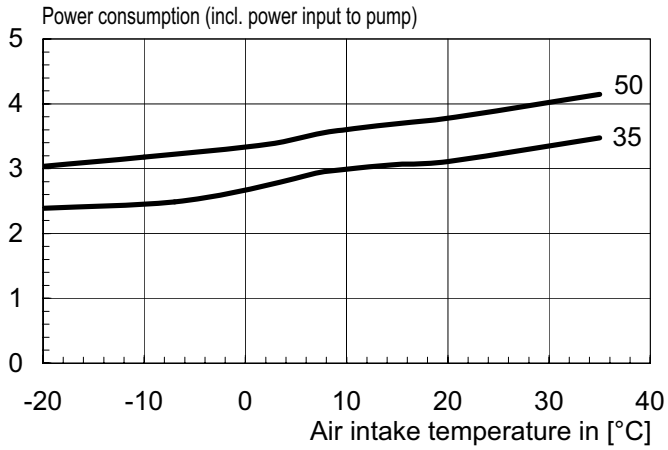


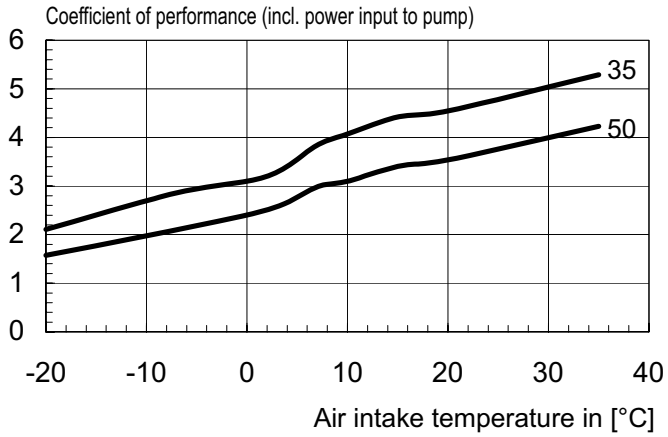


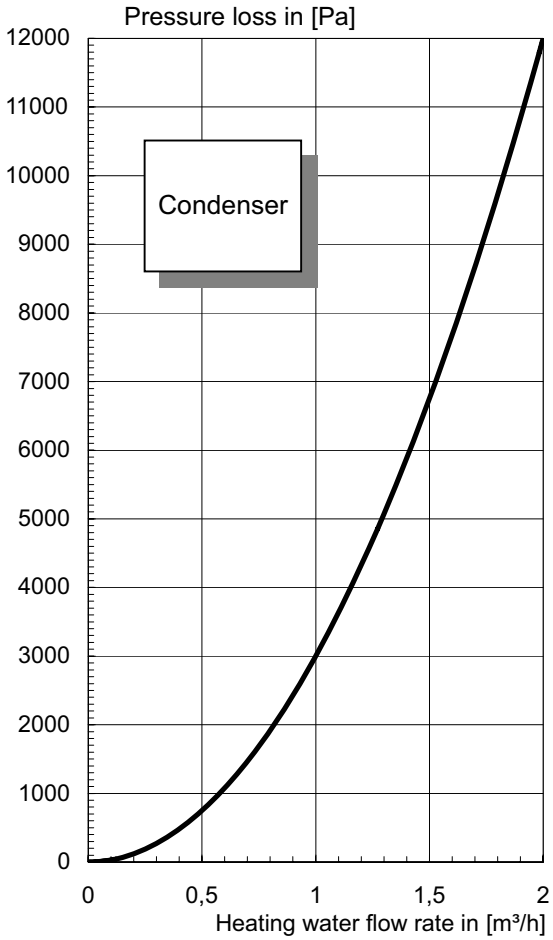


2.10.3 Characteristic curves LI 11TE / LA 11AS

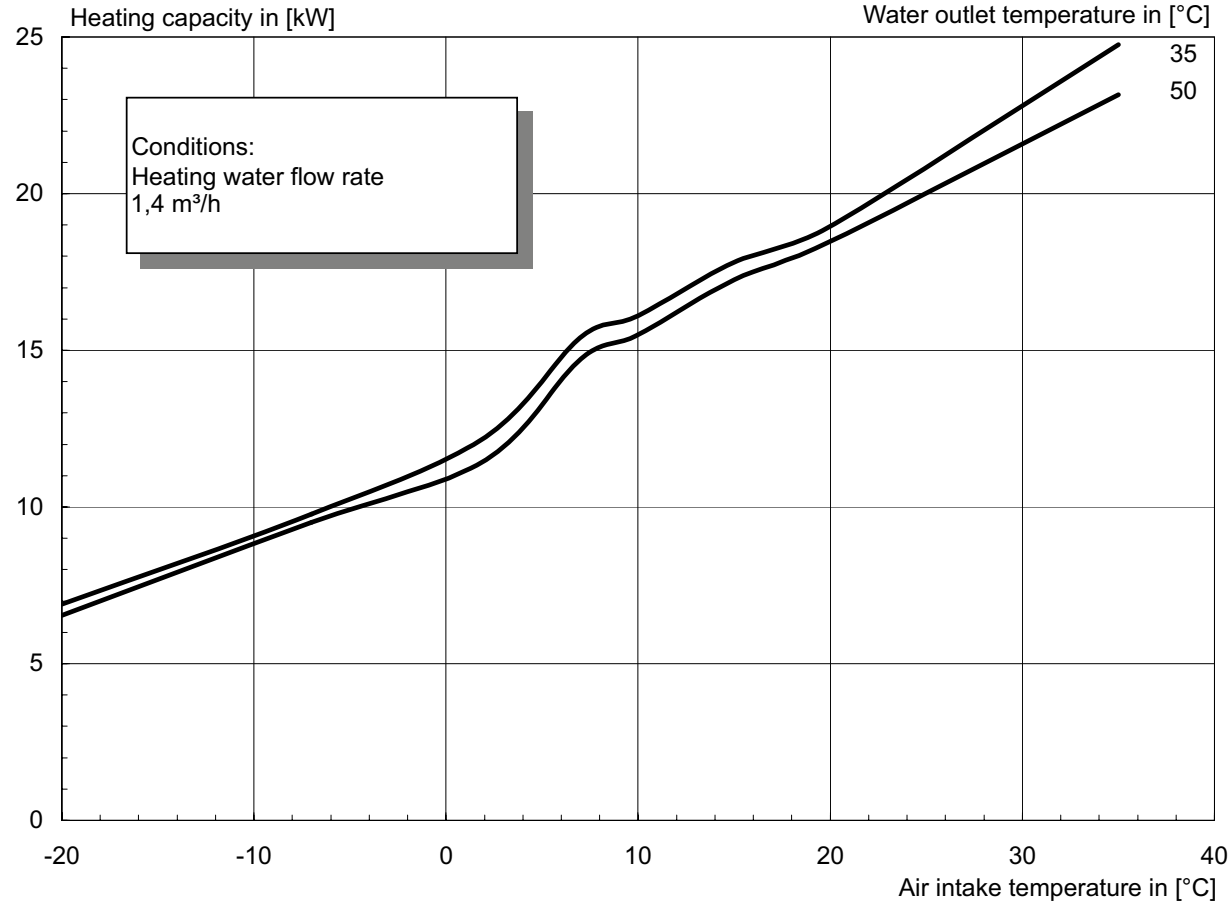


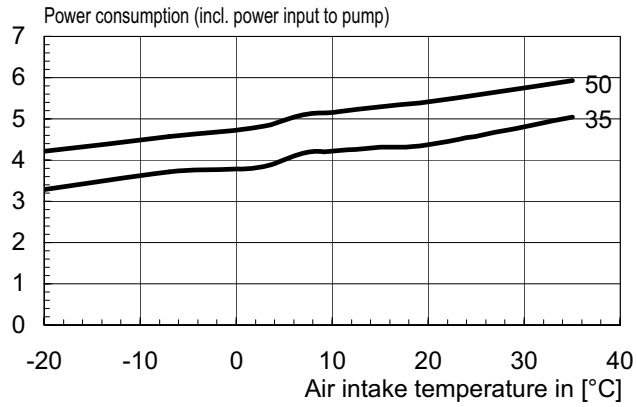


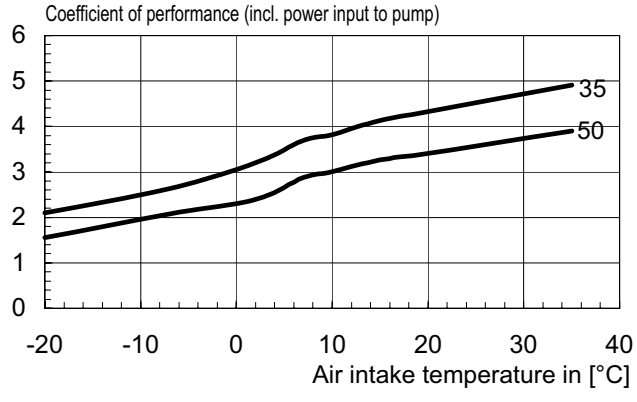


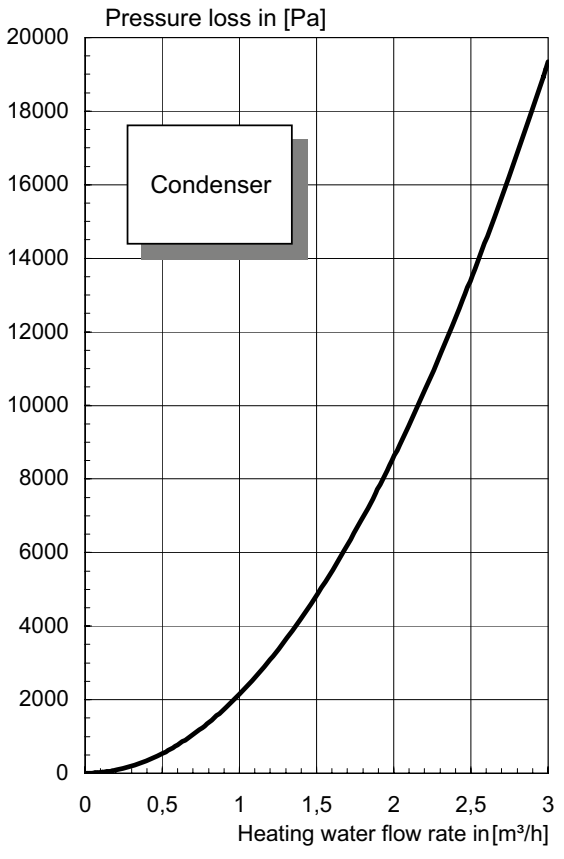


2.10.4 Characteristic curves LI 16TE / LA 16AS

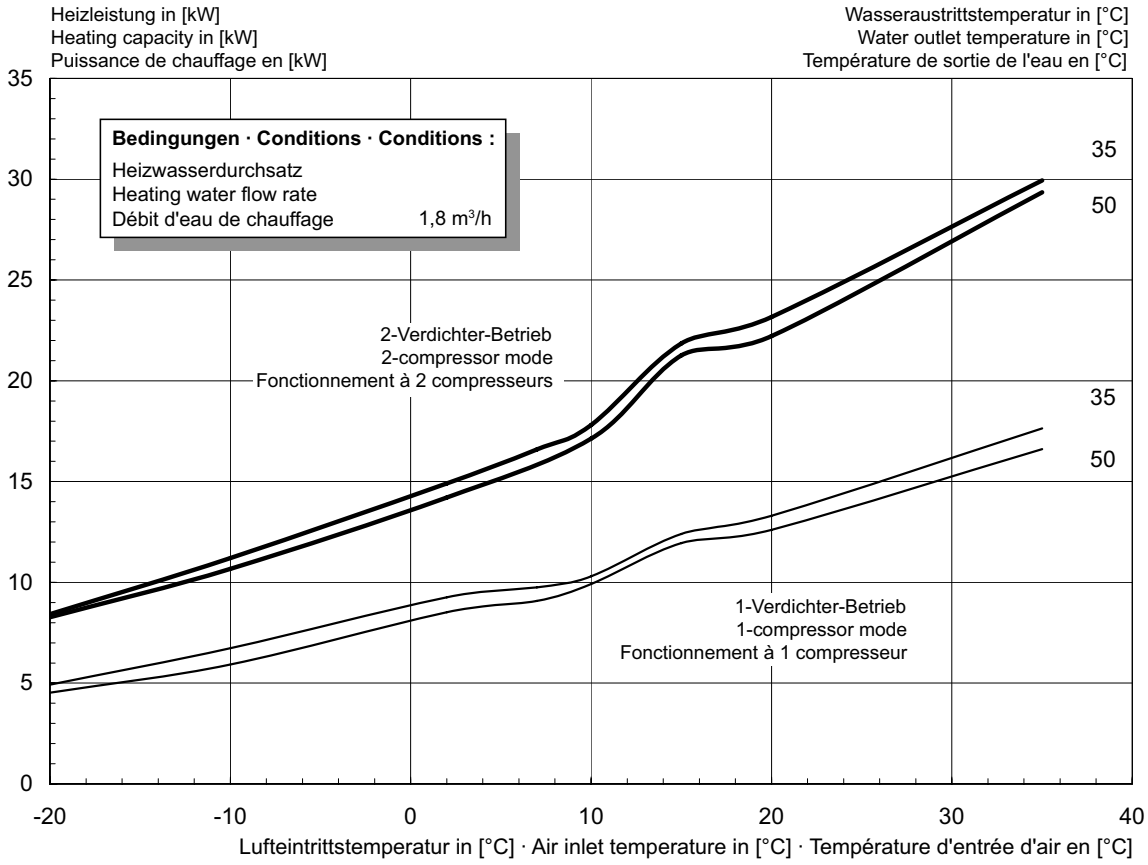


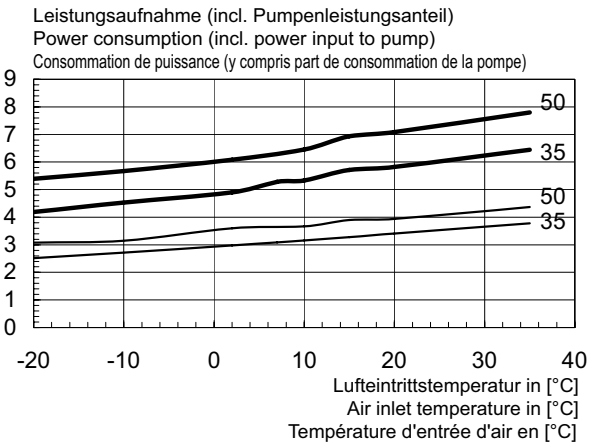


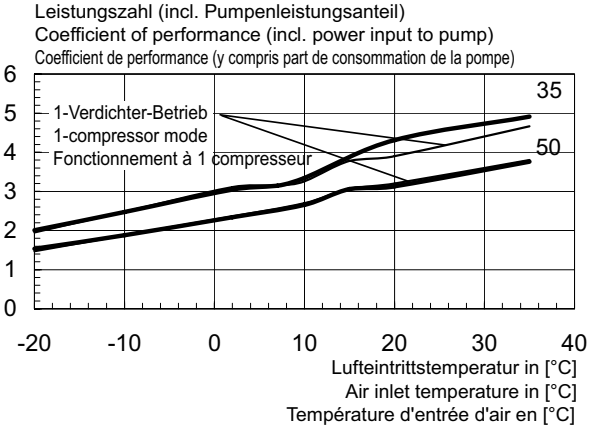


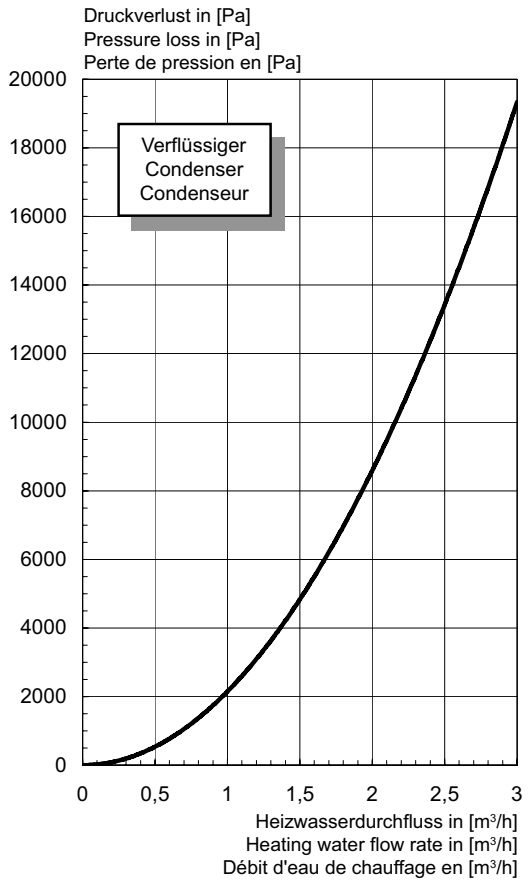


2.10.5 Characteristic curves LI 20TE / LA 20AS

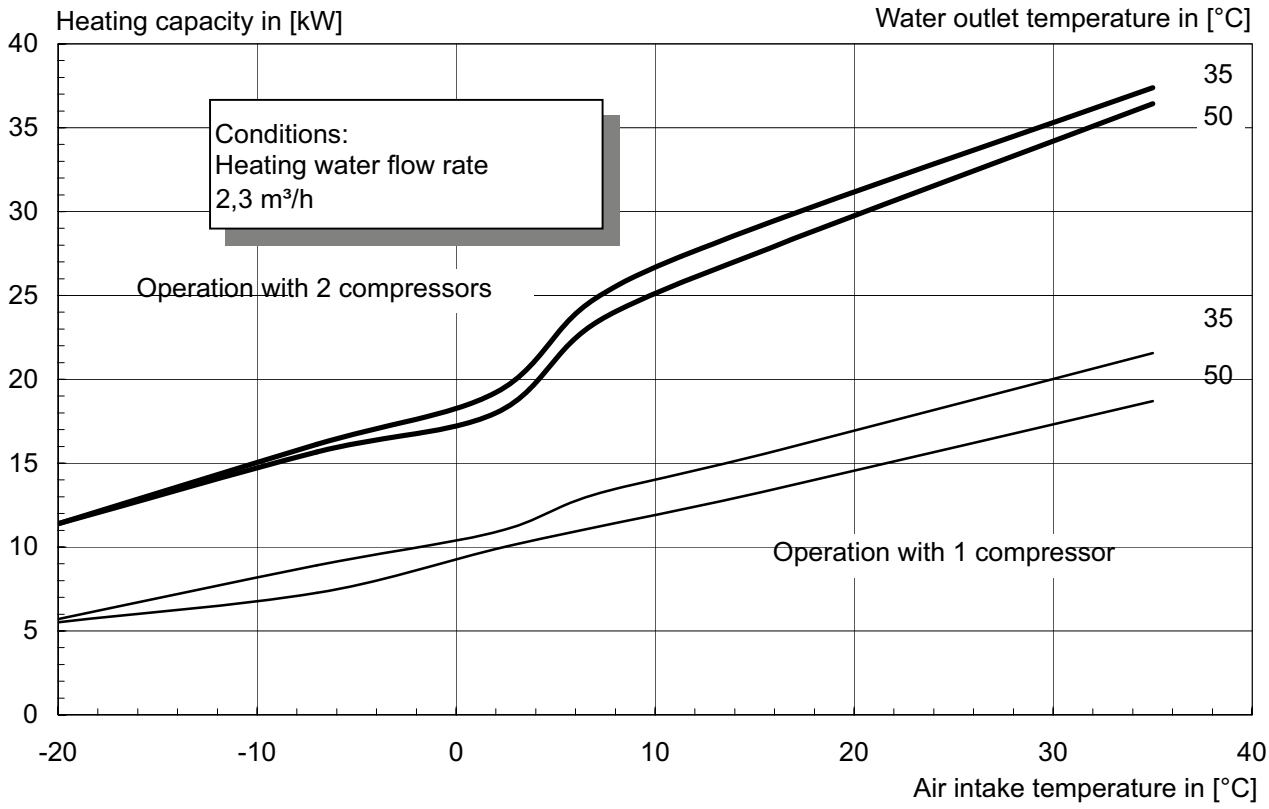


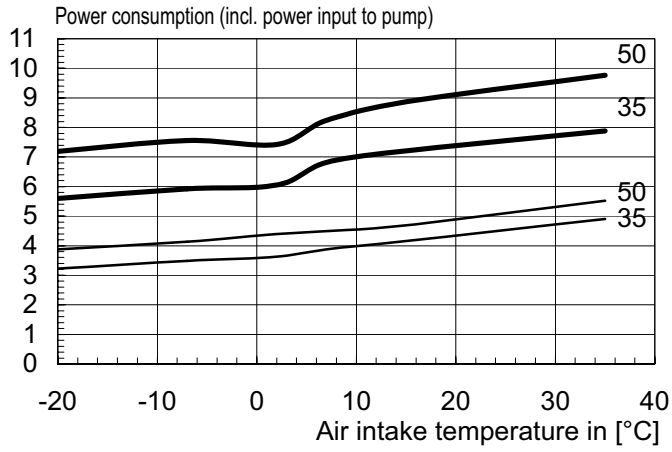


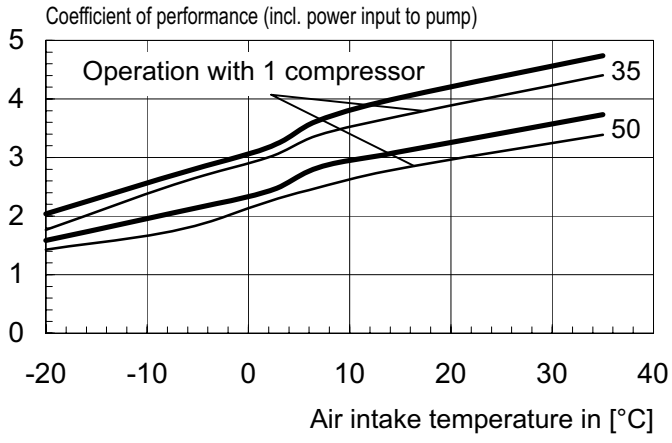

Leistungszahl (incl. Pumpenleistungsanteil)
Coefficient of performance (incl. power input to pump)
Coefficient de performance (y compris part de consommation de la pompe)
1-Verdichter-Betrieb
1-compressor mode
Fonctionnement à 1 compresseur
35
50
Lufteintrittstemperatur in [°C]
Air inlet temperature in [°C]
Température d'entrée d'air en [°C]

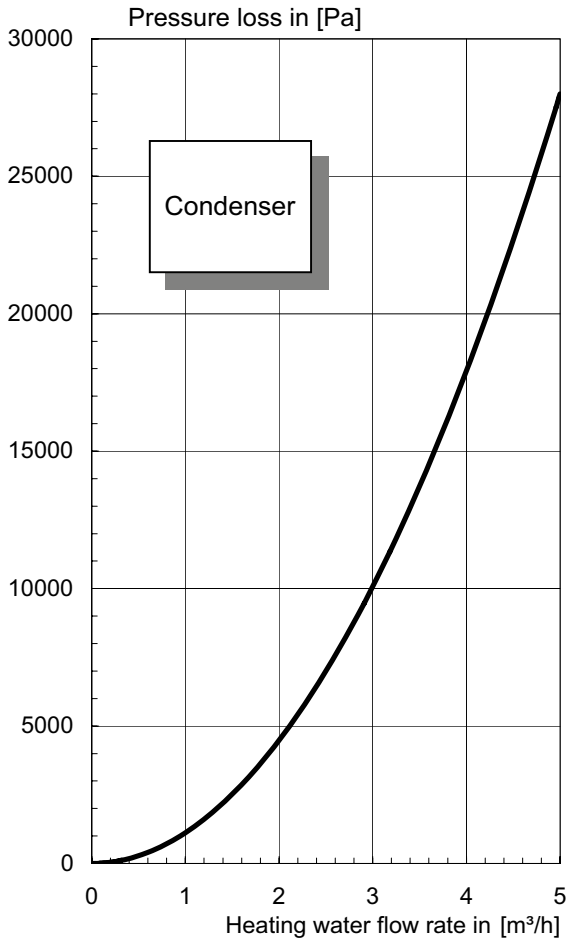


2.10.6 Characteristic curves LI 24TE / LA 24AS

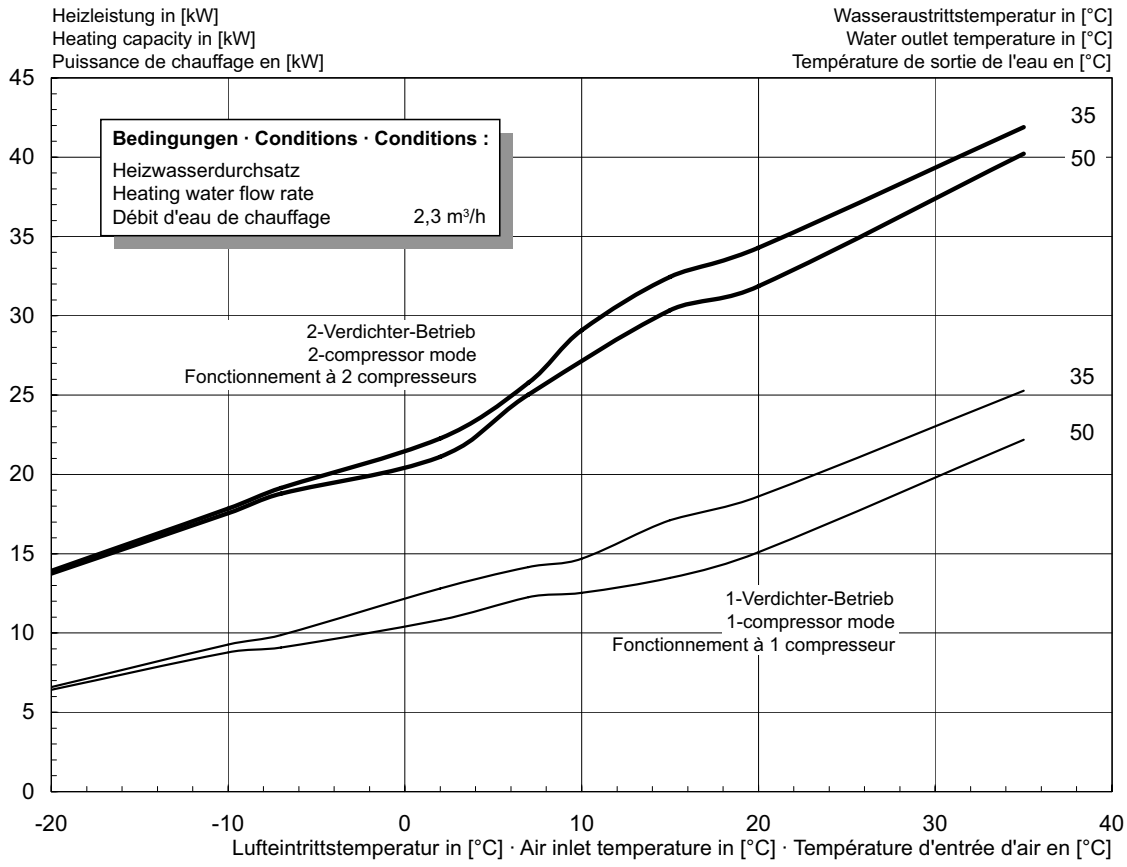


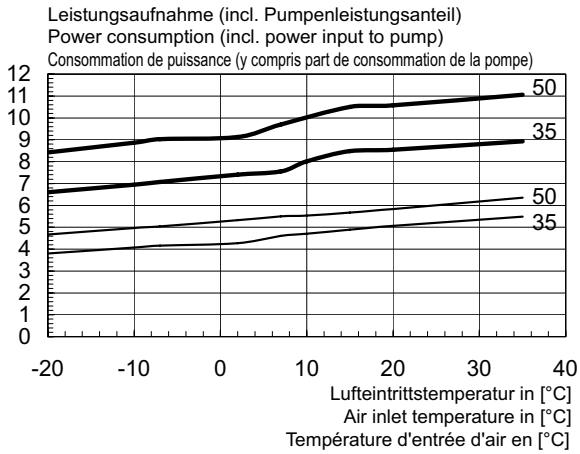


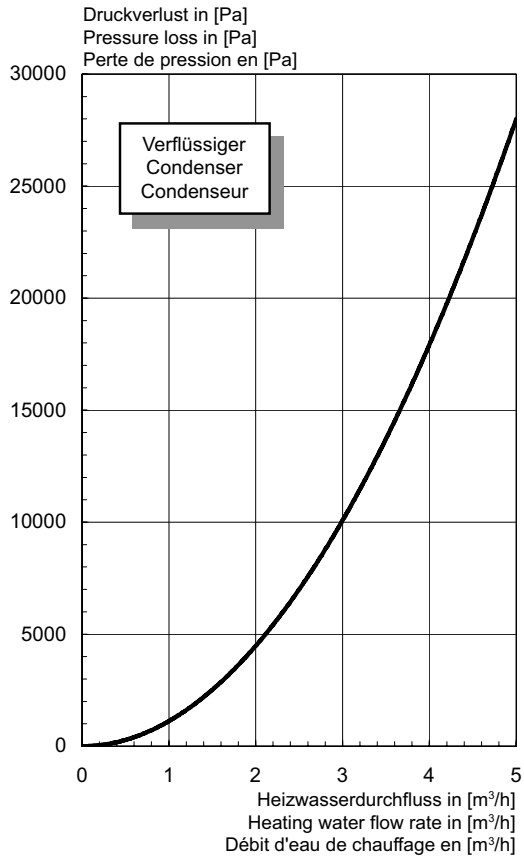


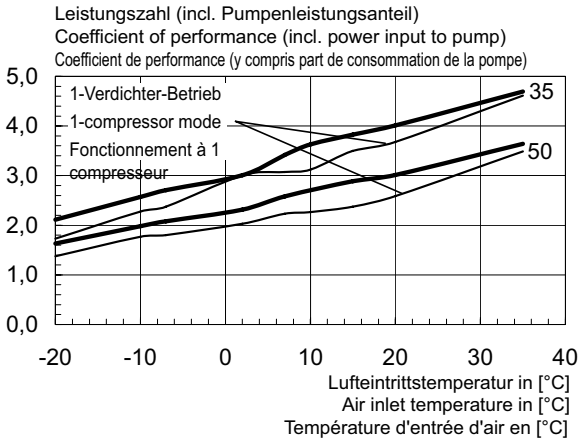


2.10.7 Characteristic curves LI 28TE / LA 28AS

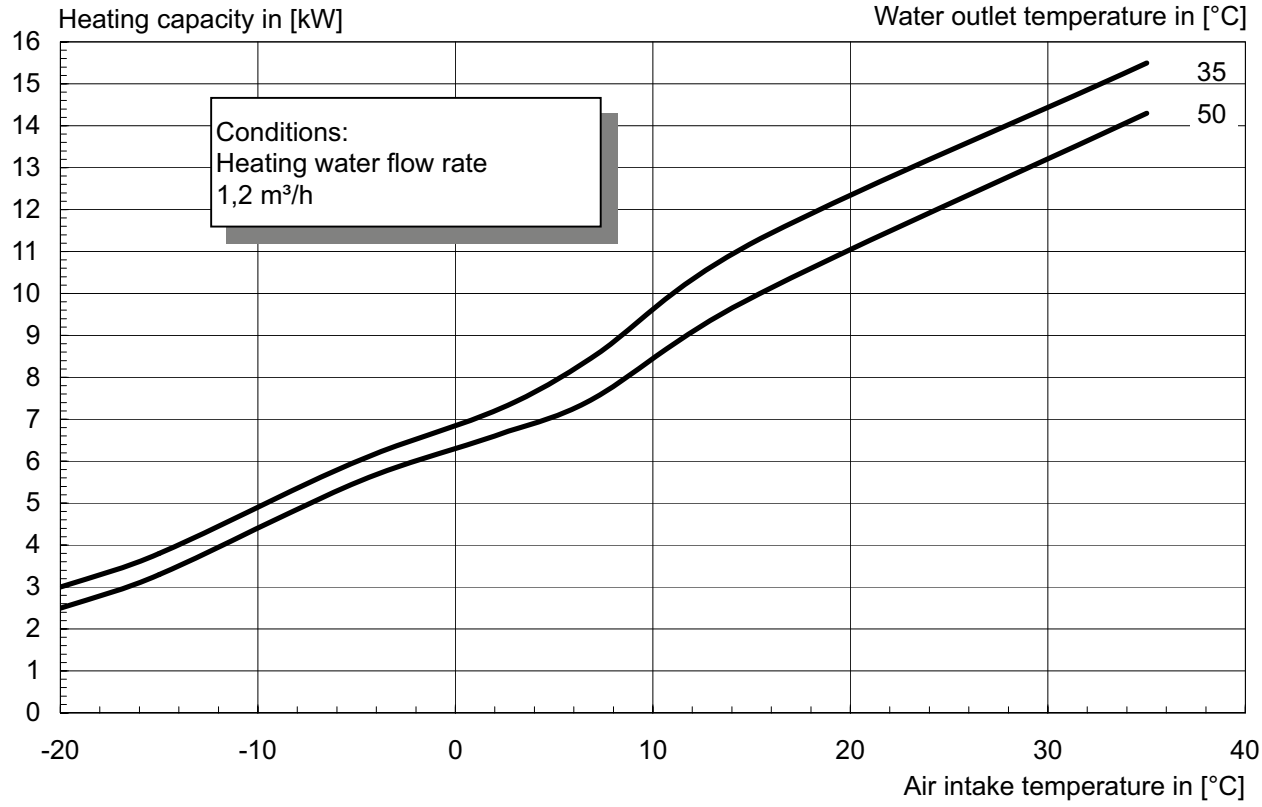


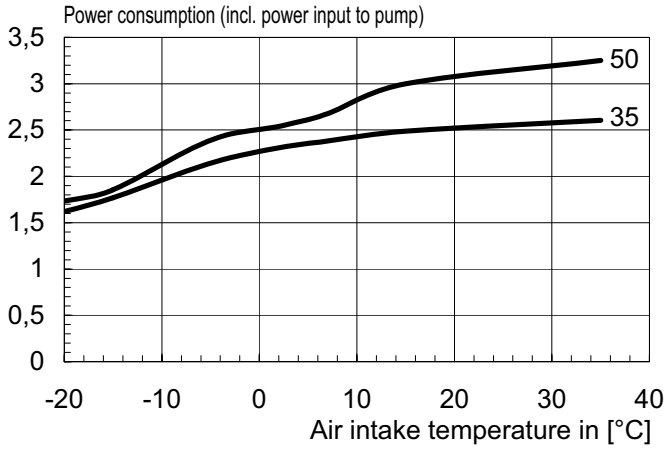


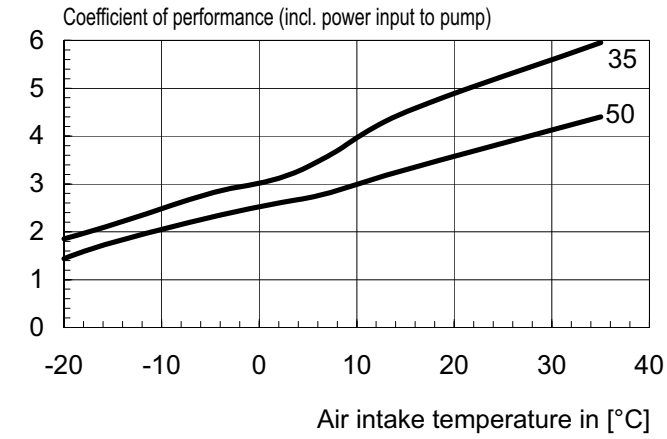


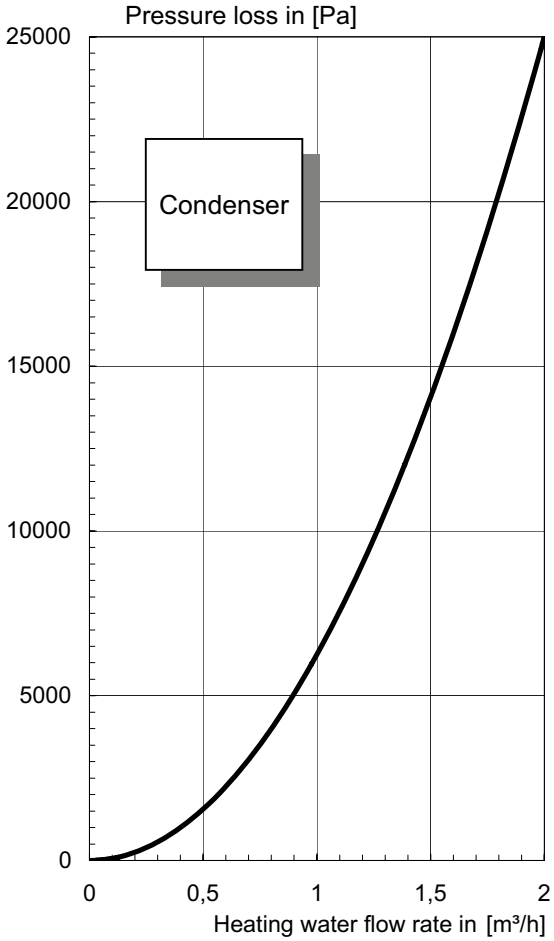

Leistungszahl (incl. Pumpenleistungsanteil)
Coefficient of performance (incl. power input to pump)
Coefficient de performance (y compris part de consommation de la pompe)
1-Verdichter-Betrieb
1-compressor mode
Fonctionnement à 1 compresseur
35
50
Lufteintrittstemperatur in [°C]
Air inlet temperature in [°C]
Température d'entrée d'air en [°C]

2.10.8 Characteristic curves LA 9PS

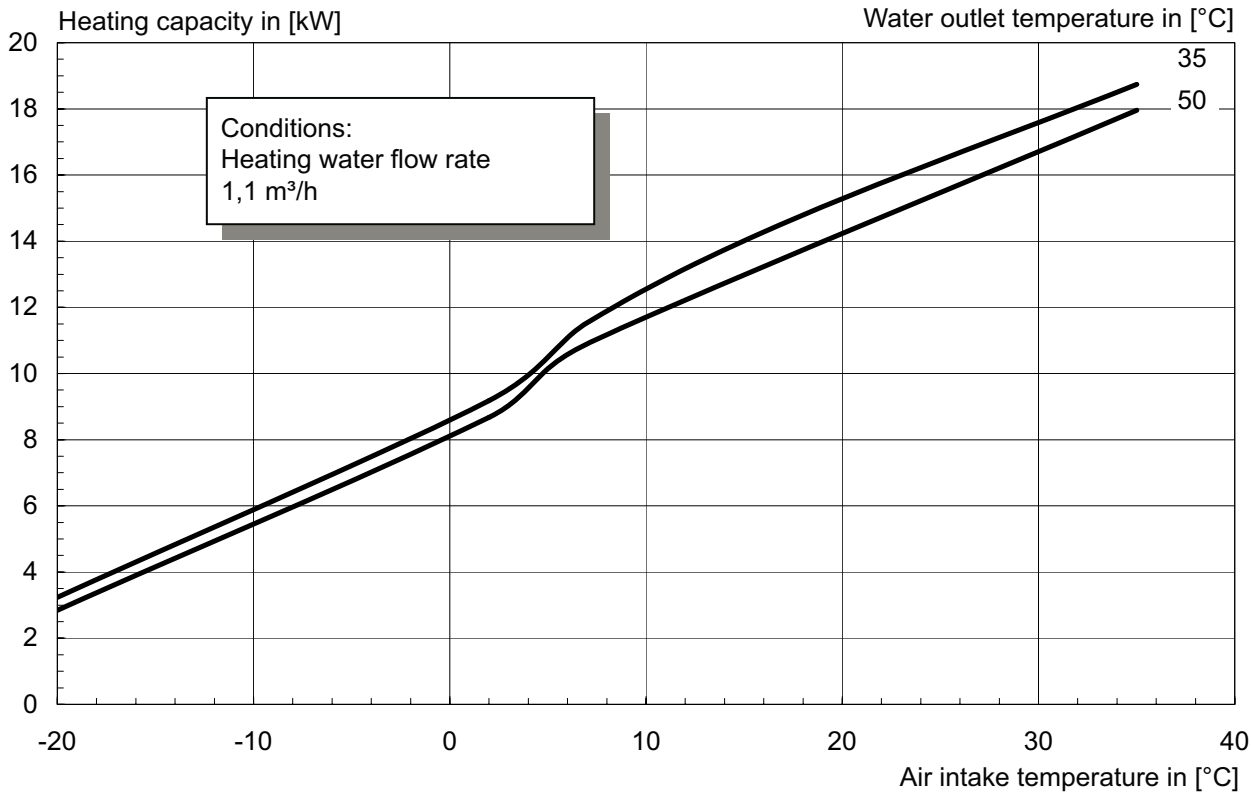


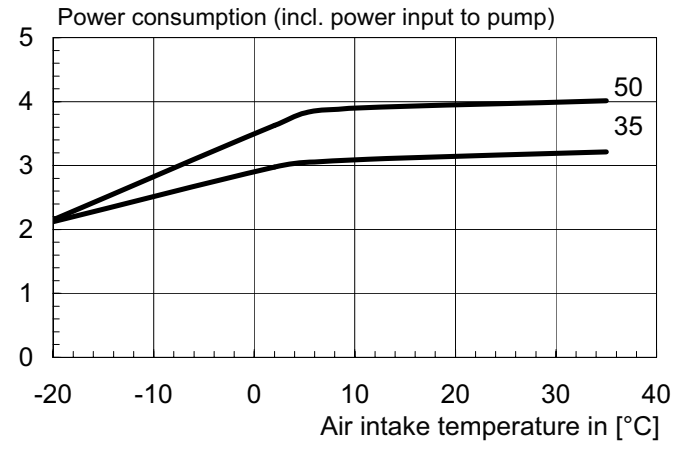


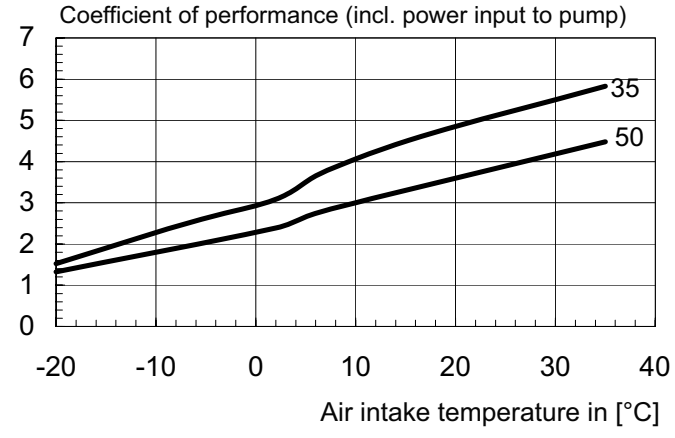


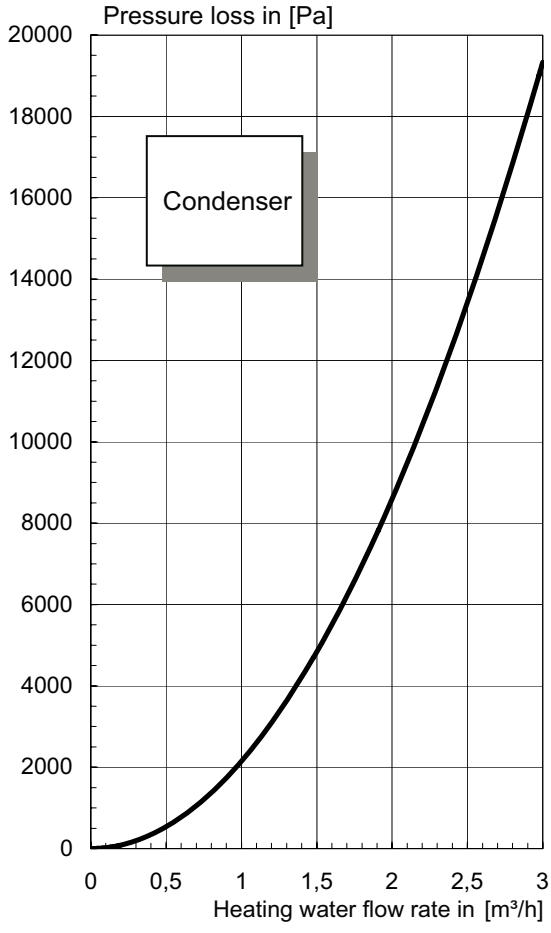


2.10.9 Characteristic curves LA 11PS

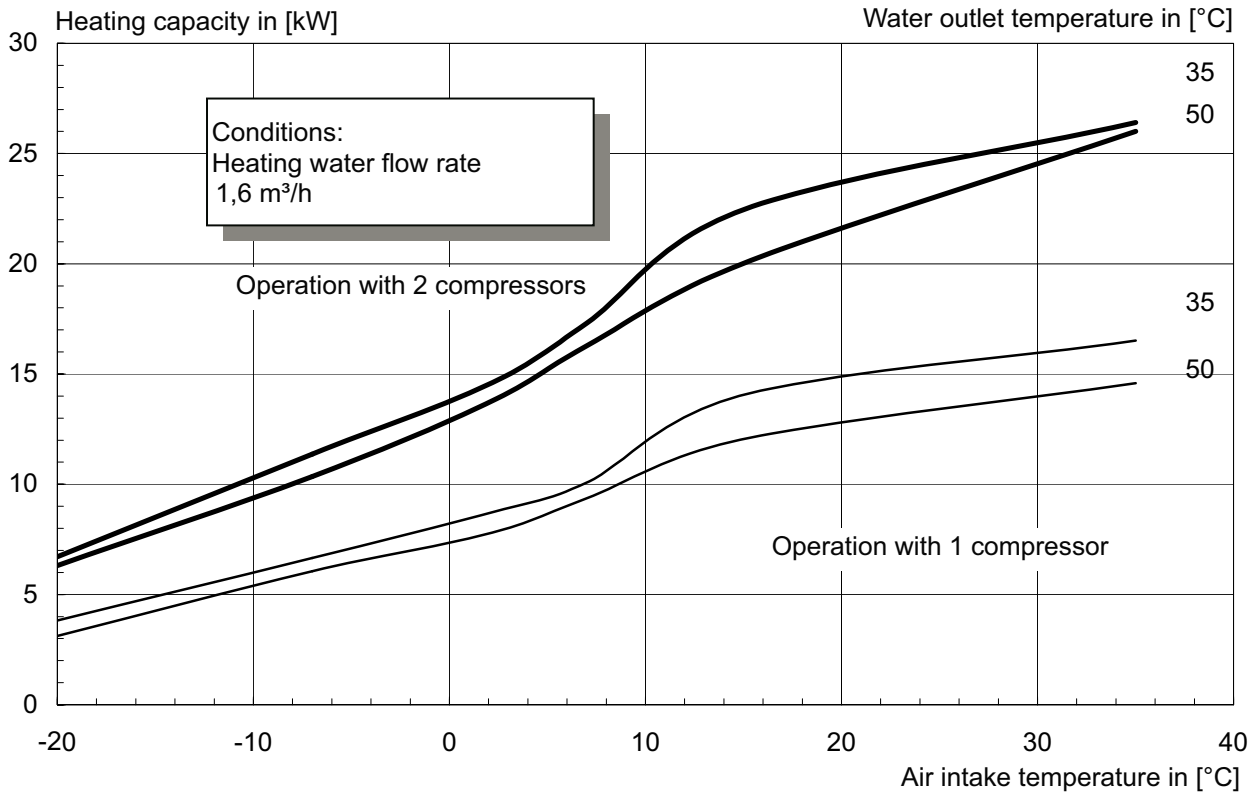


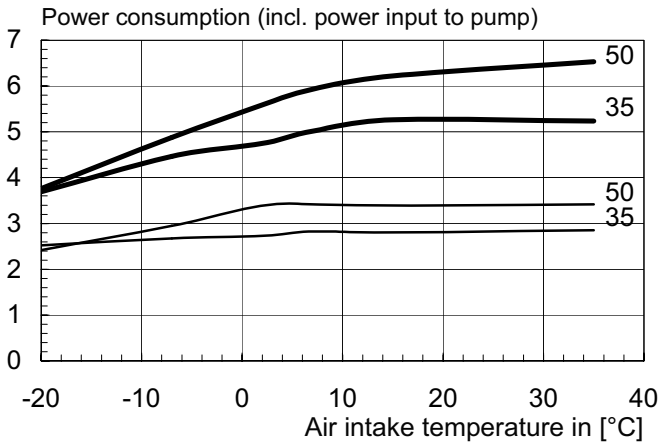


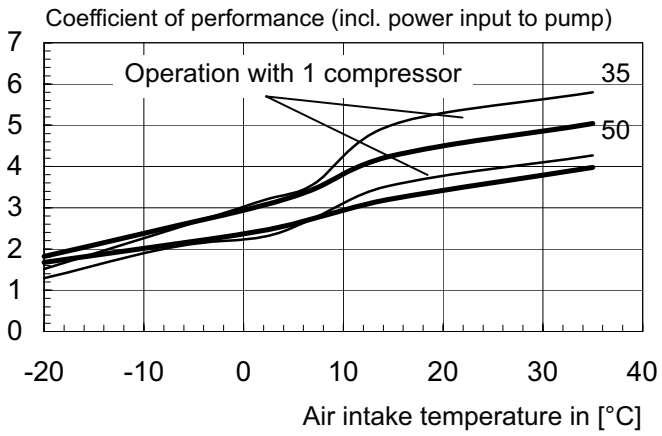


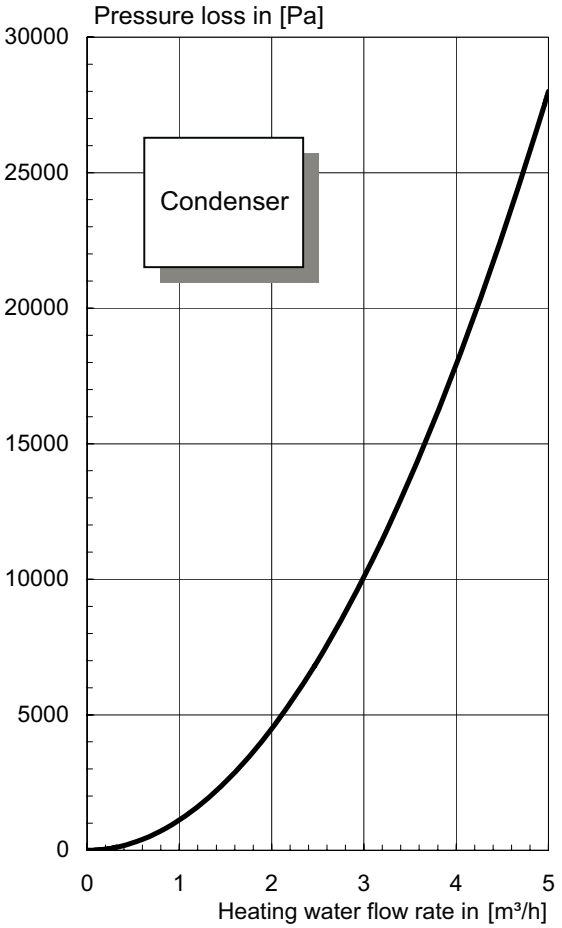


2.10.10 Characteristic curves LA 17PS

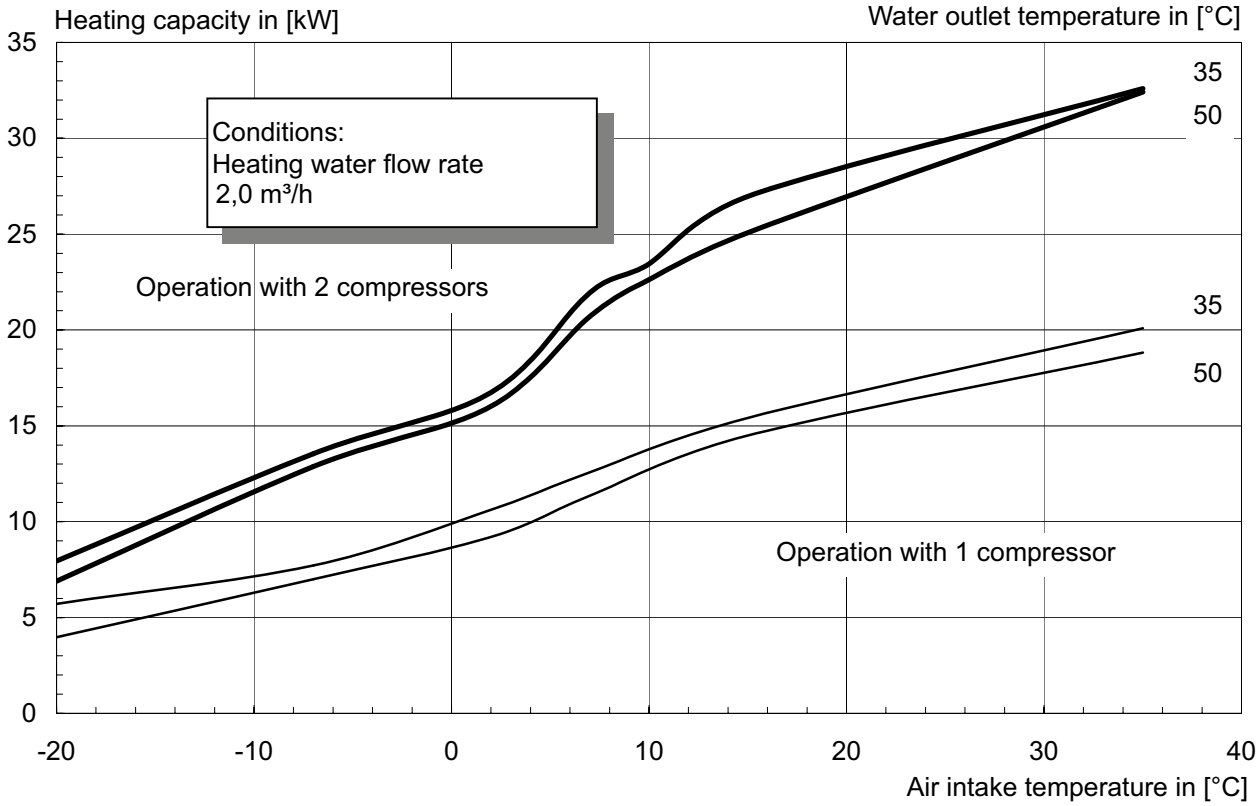


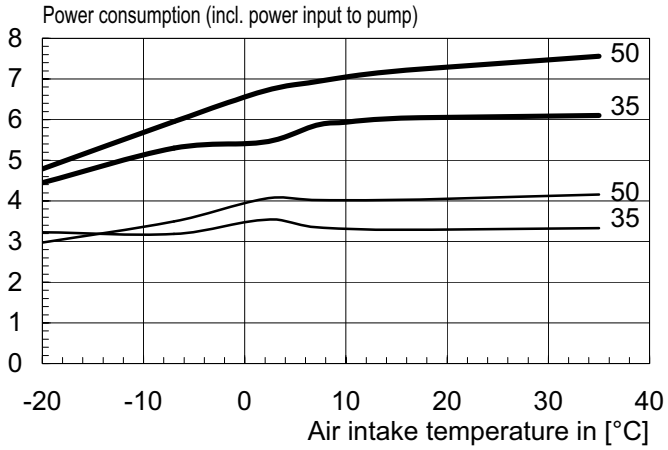


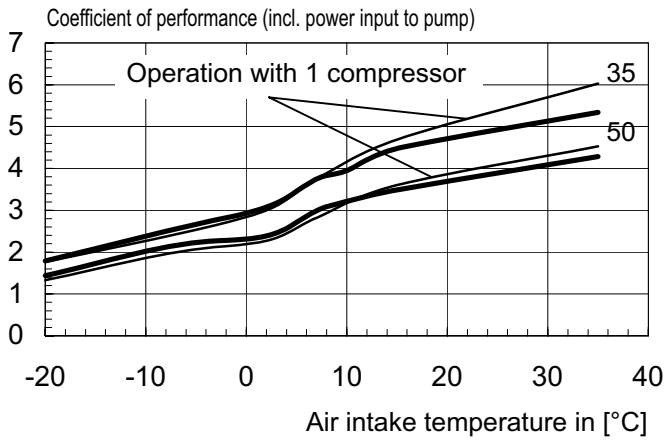


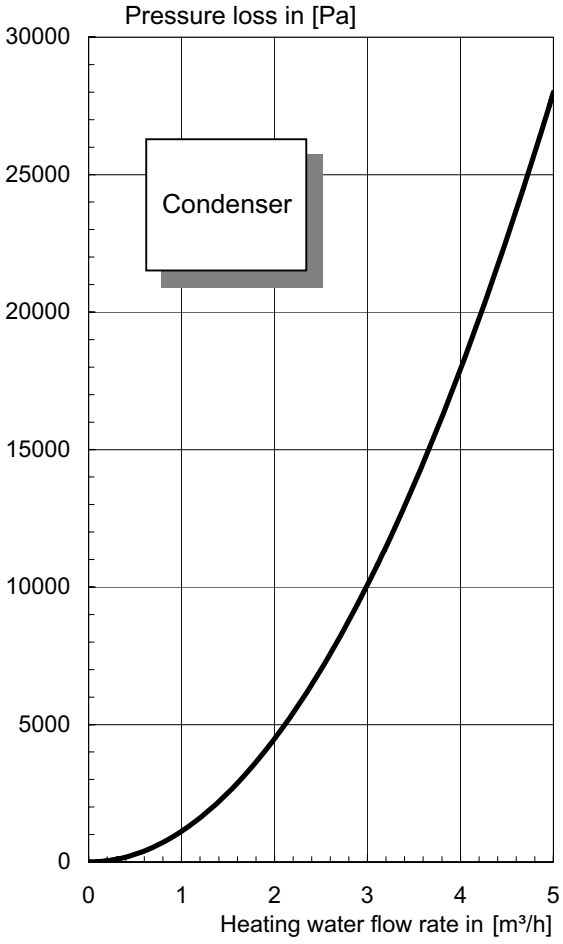


2.10.11 Characteristic curves LA 22PS

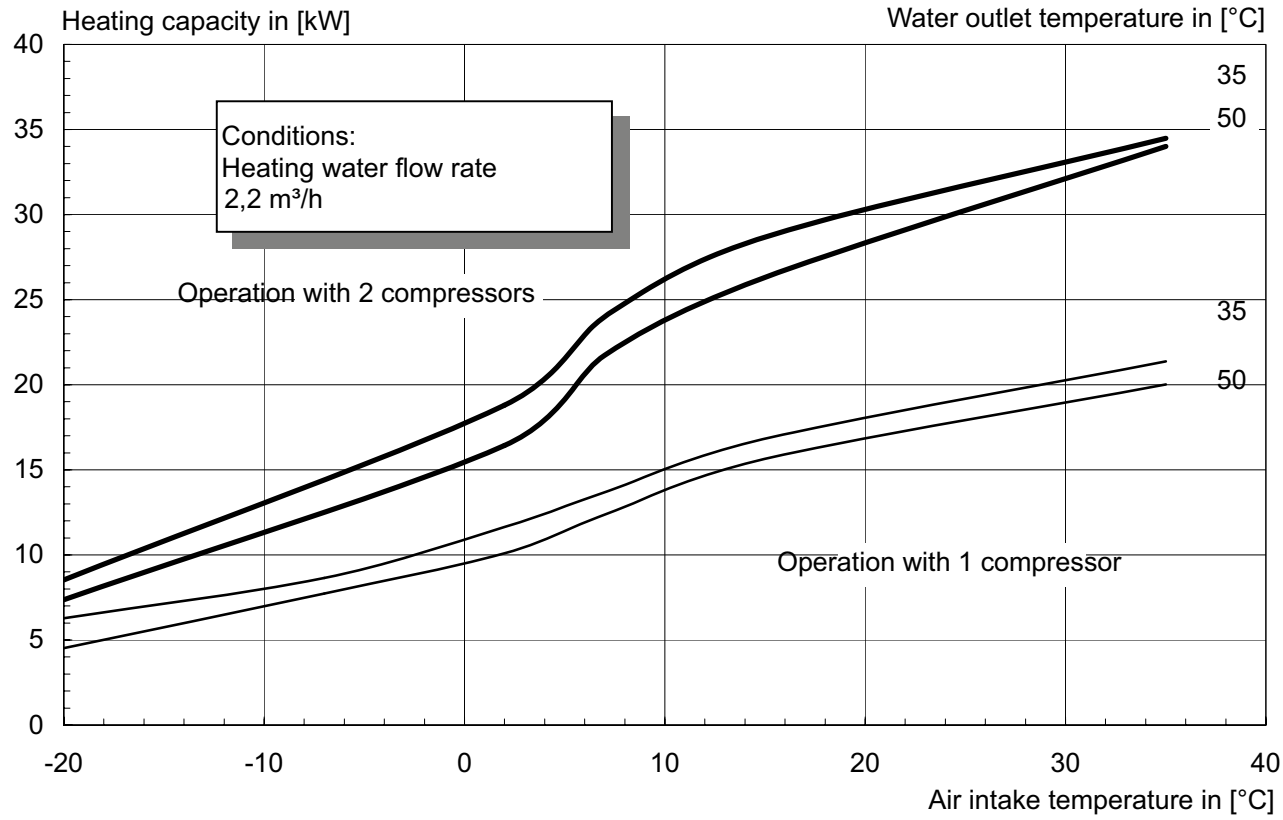


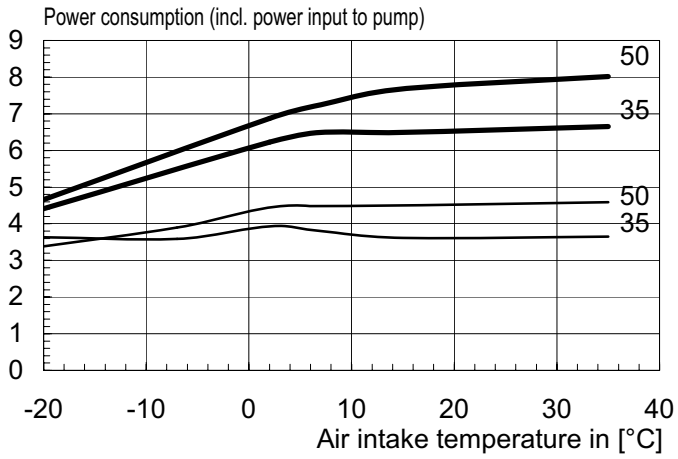


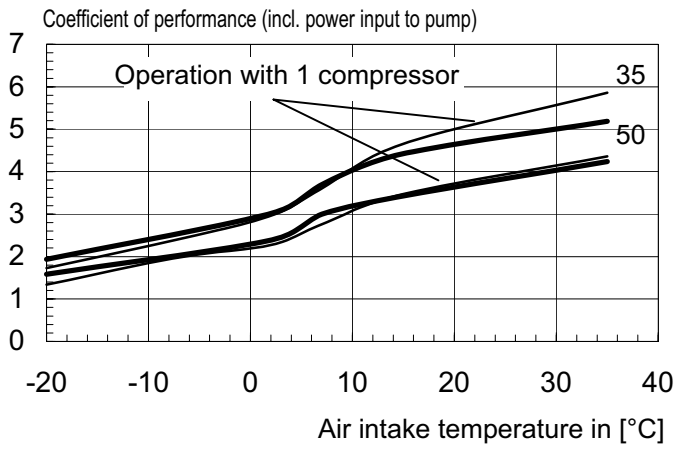


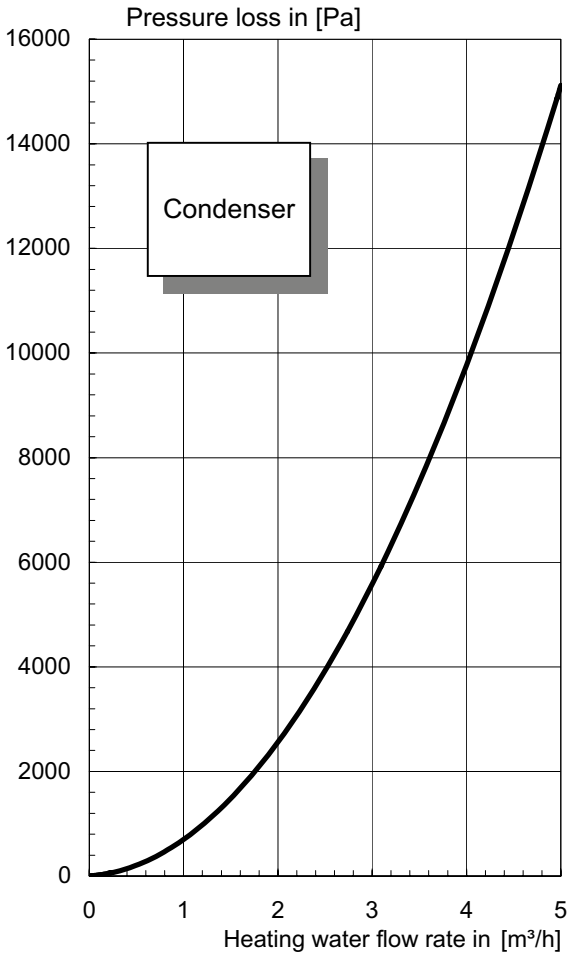


2.10.12 Characteristic curves LA 26PS

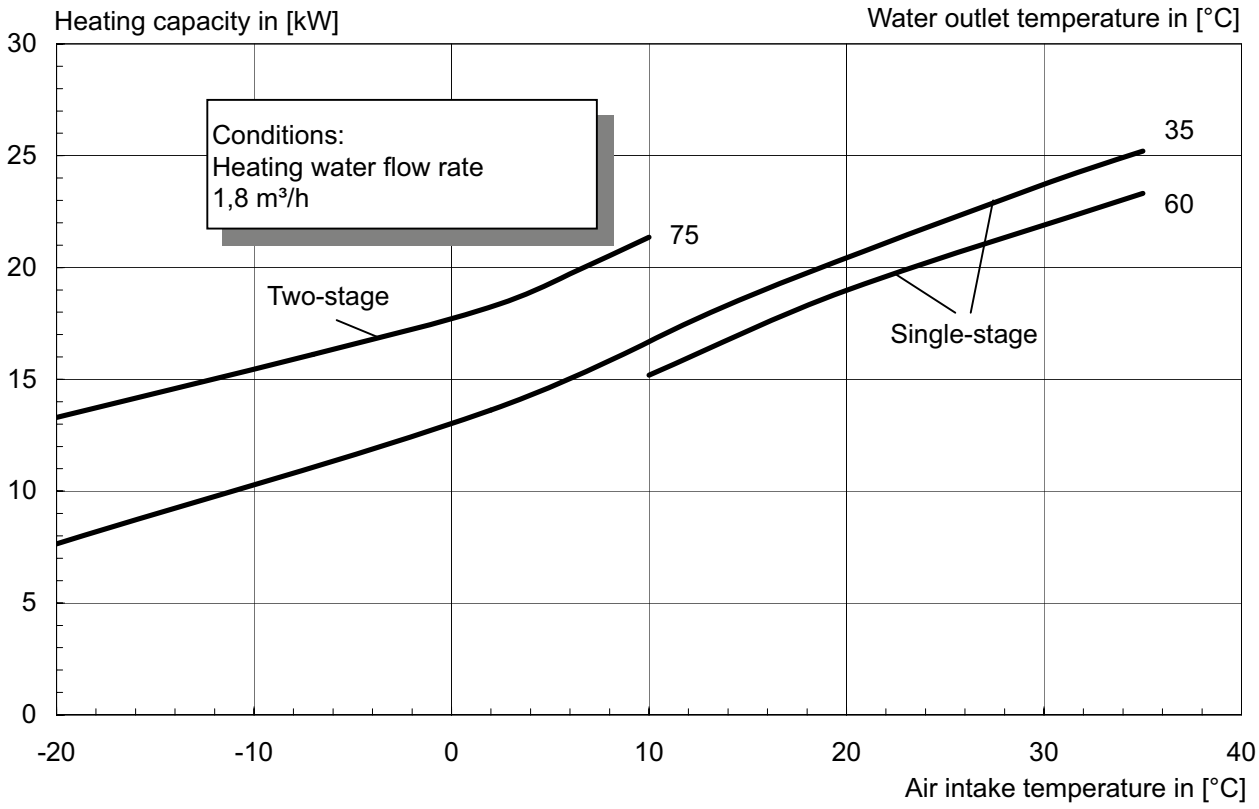


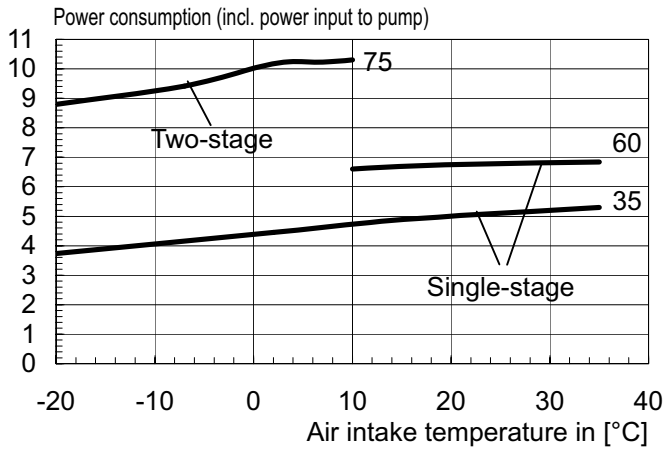


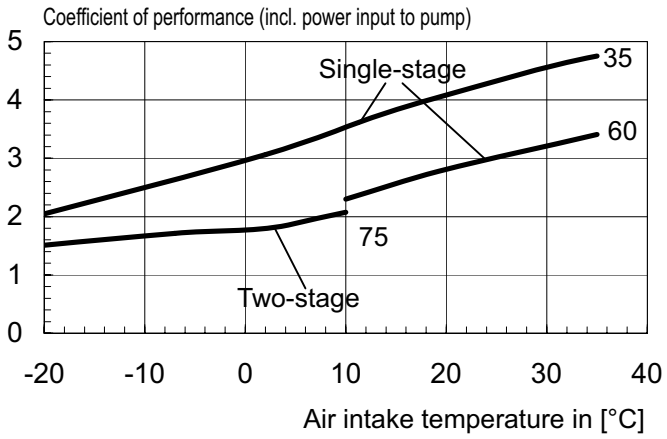


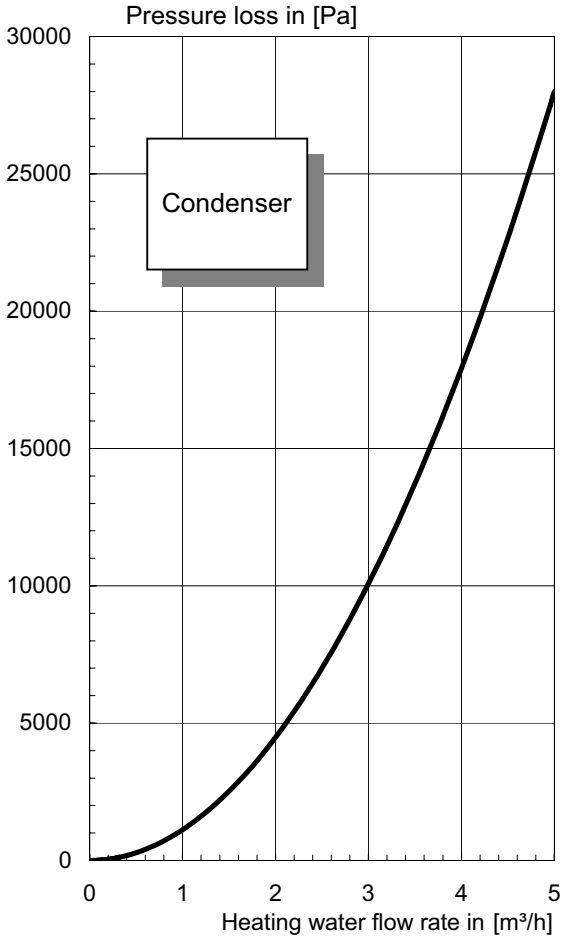


2.10.13 Characteristic curves LIH 22TE / LA 22HS

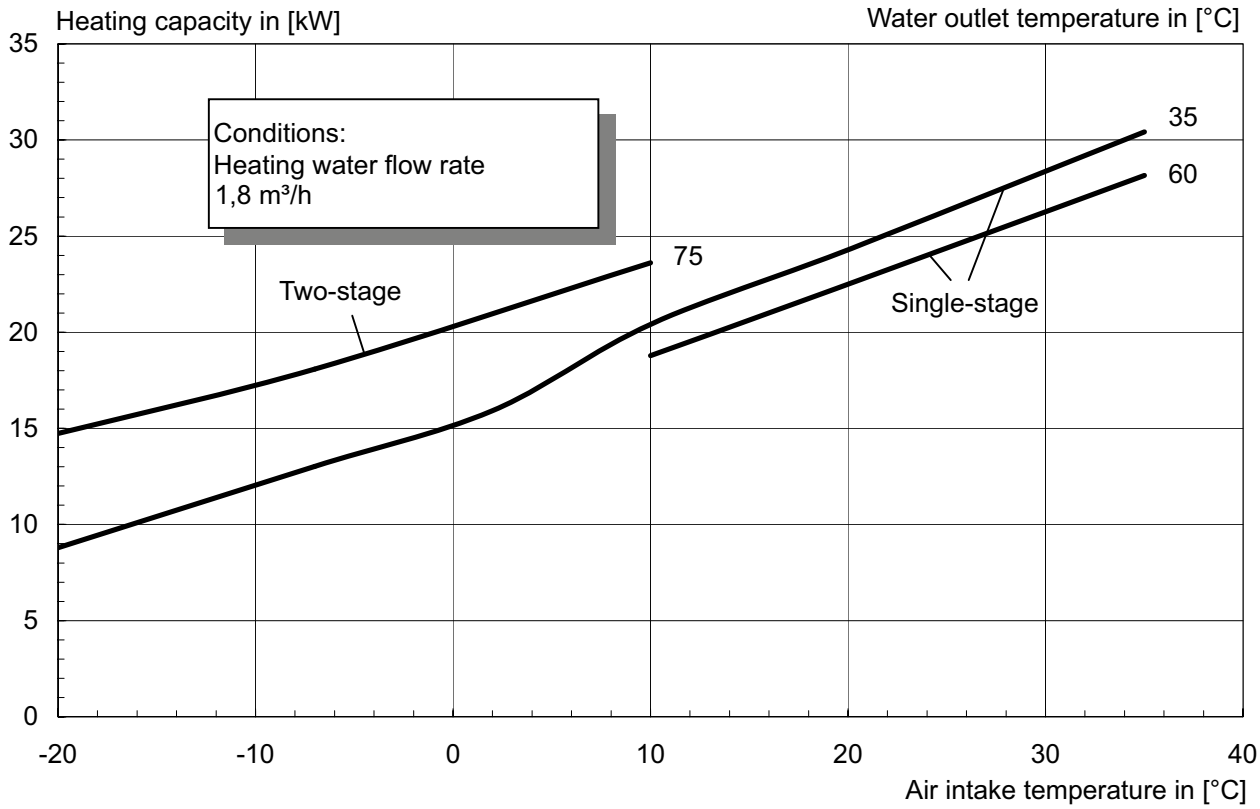


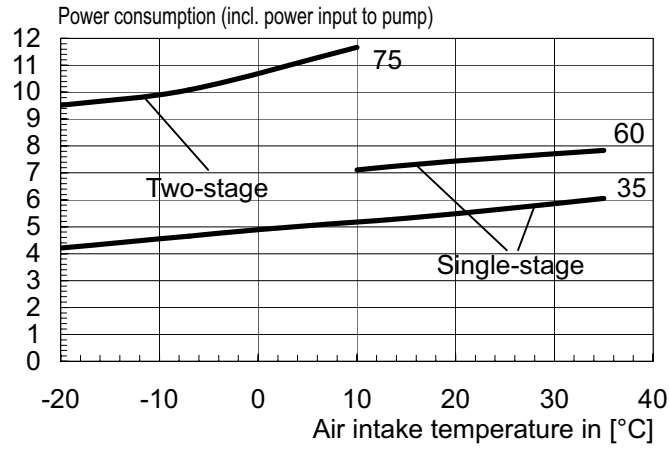


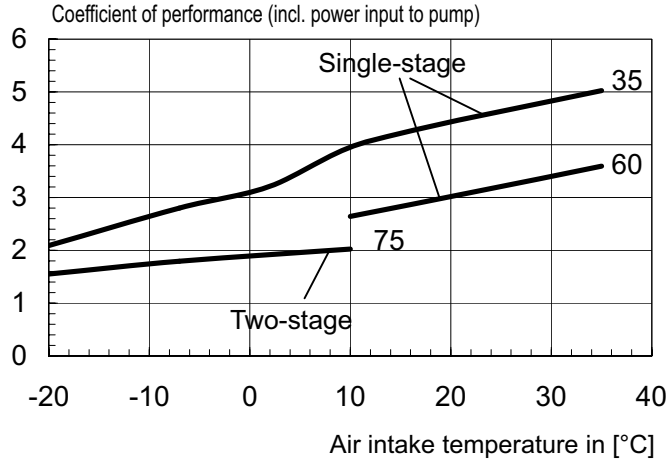


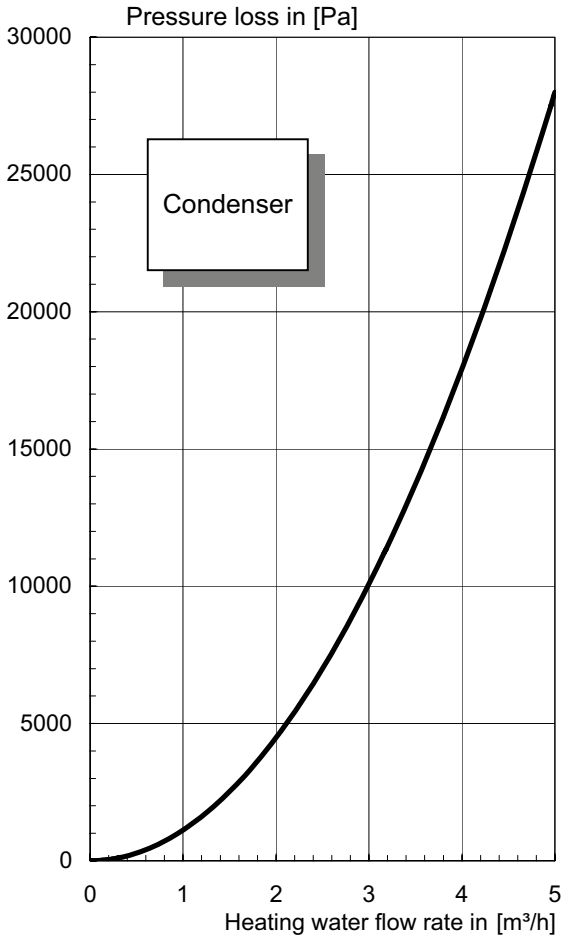


2.10.14 Characteristic curves LIH 26TE / LA 26HS



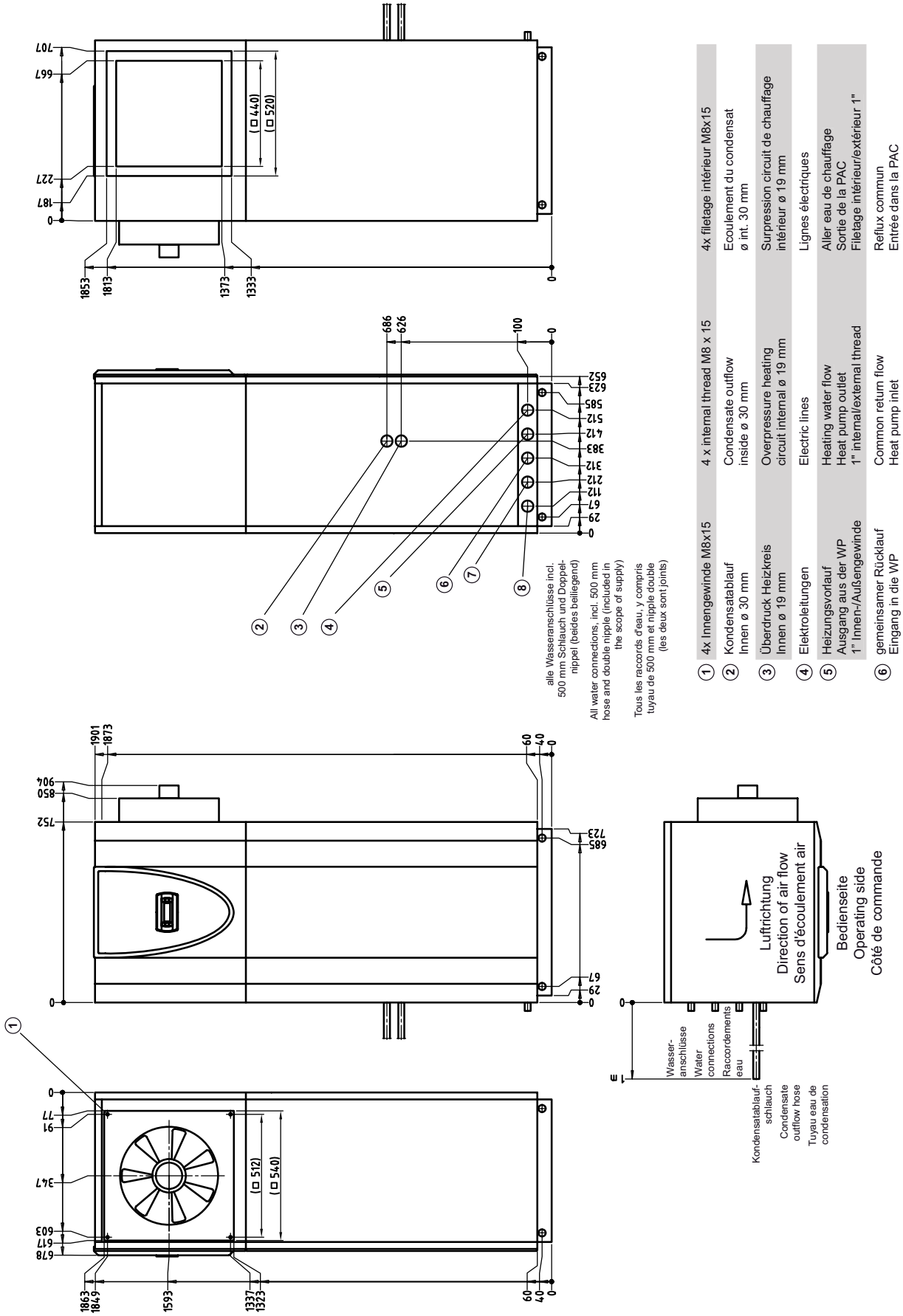






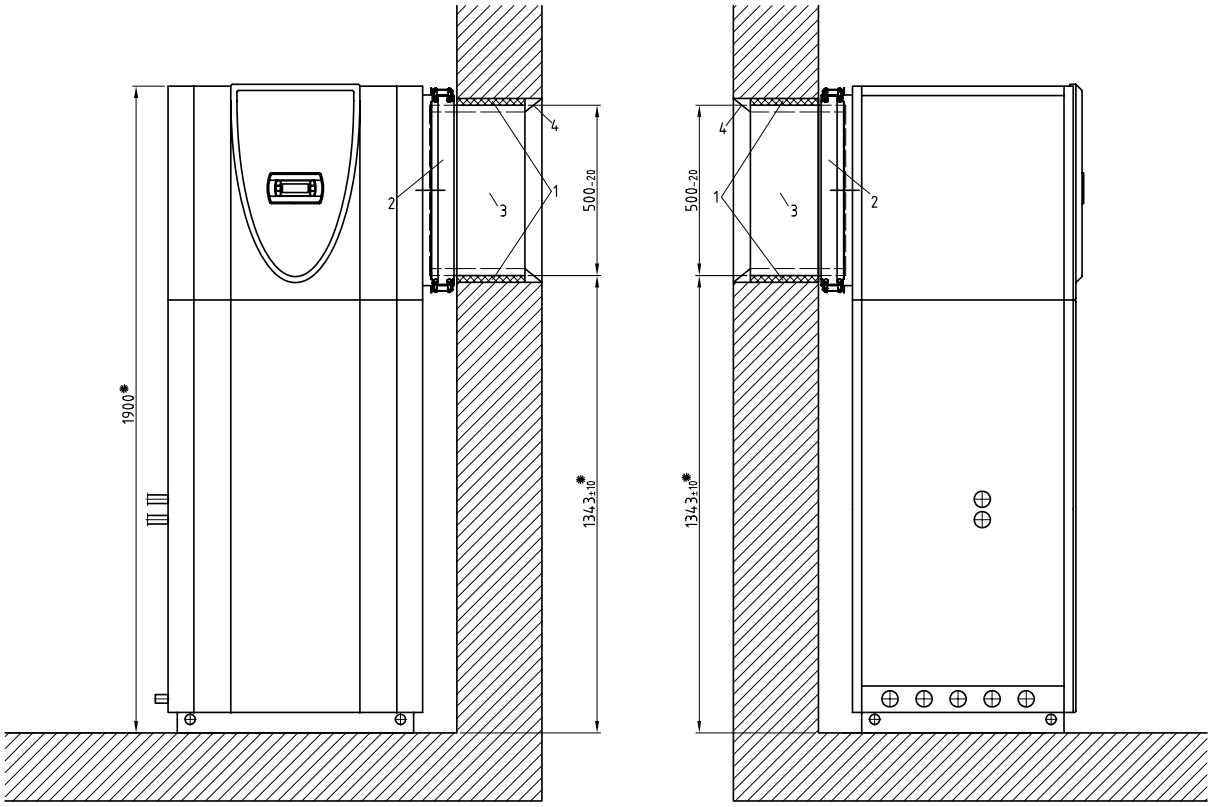
2.11 Dimensions of Air-to-Water Heat Pumps

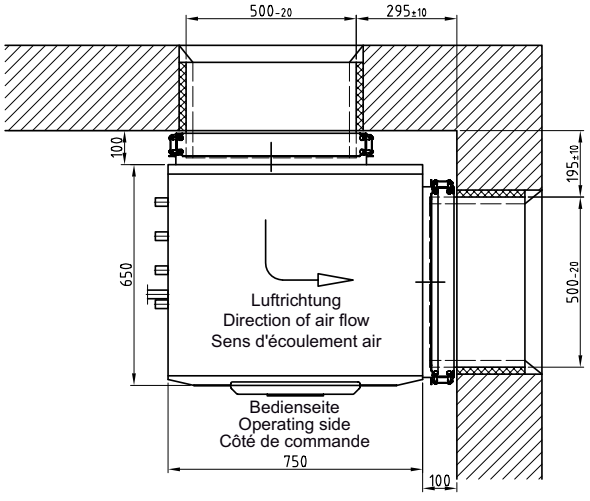
2.11.1 Dimensions LIK 8ME / LIK 8TE



①	4x Innengewinde M8x15	4 x internal thread M8 x 15	4x filetage intérieur M8x15
②	Kondensatablauf Innen ø 30 mm	Condensate outflow inside ø 30 mm	Ecoulement du condensat ø int. 30 mm
③	Überdruck Heizkreis Innen ø 19 mm	Overpressure heating circuit internal ø 19 mm	Surpression circuit de chauffage intérieur ø 19 mm
④	Elektroleitungen	Electric lines	Lignes électriques
⑤	Heizungsvorlauf Ausgang aus der WP 1" Innen-/Außengewinde	Heating water flow Heat pump outlet 1" internal/external thread	Aller eau de chauffage Sortie de la PAC Filetage intérieur/extérieur 1"
⑥	gemeinsamer Rücklauf Eingang in die WP 1" Innen-/Außengewinde	Common return flow Heat pump inlet 1" internal and external threads	Reflux commun Entrée dans la PAC Filetages int./ext. 1"
⑦	Füll- und Entleerungshahn	Feed and drain tap	Robinet de remplissage et de vidage
⑧	Warmwasservorlauf Ausgang aus der WP 1" Innen-/Außengewinde	Hot water flow Heat pump outlet 1" internal / external thread	Départ eau chaude Sortie de la PAC Filetage int./ext. 1"

Installation on a wall





1: handelsüblicher Bauschaum (bauseits)
Standard polyurethane foam (to be provided by the customer)
Mousse de construction courante (à fournir par le client)

2: Dichtmanschette (als Zubehör erhältlich)
Sealing collar (available as an accessory)
Manchon d'étancheité (disponible en accessoire)

3: Luftkanal (als Zubehör erhältlich)
Air duct (available as an accessory)
Conduit d'aération (disponible en accessoire)

4: Umlaufende Abschrägung (bauseits)
zur Abdichtung der Stoßkante und
Verbesserung der Luftführung
Continuous chamfer (to be provided by the customer)
to seal the border and to facilitate air circulation
Chanfrein périphérique (à fournir par le client) assurant
l'étanchéité du bord et améliorant la conduite de l'air

*: Bei Einsatz eines Dämmstreifens unter der Wärmepumpe
muss das Maß entsprechend erhöht werden.
The dimensions must be increased correspondingly
when an insulating strip is used under the heat pump.
En cas d'utilisation d'une bande isolante sous la pompe
à chaleur, augmenter la cote en correspondance.

Important information:

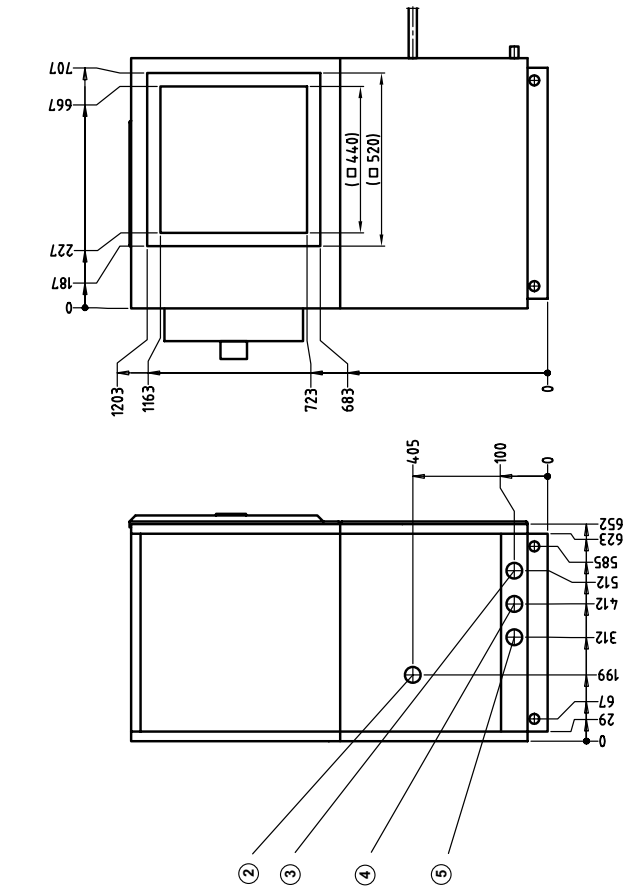
- For an installation set-up without an air duct, it is imperative that the interior side of the wall opening is lined with thermal insulation to prevent the wall from becoming cold and to prevent moisture from penetrating the wall (e.g. 50 mm rigid polyurethane foam/aluminium foil).

Legend:

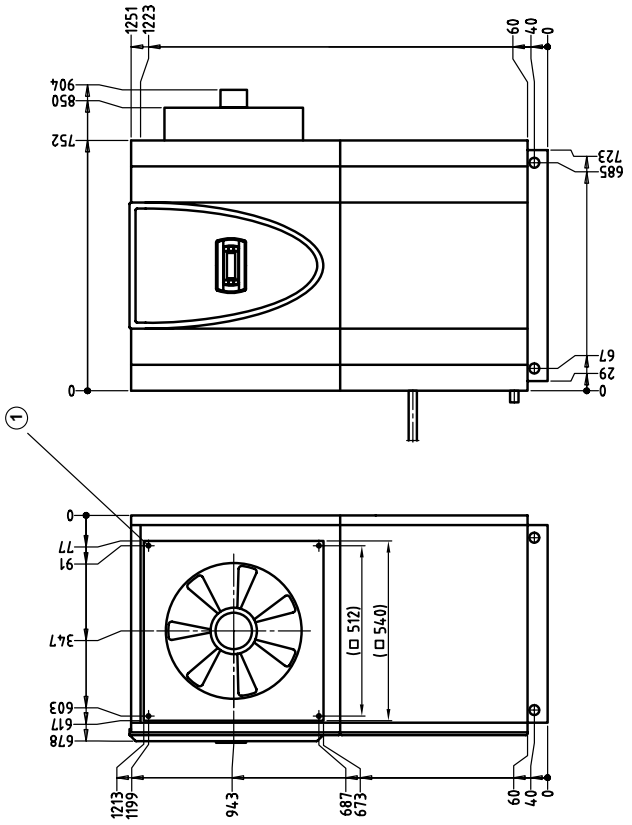
1) Standard polyurethane foam
2) Sealing collar
3) Air duct
4) Bevel for sealing the edges and improving the air circuit

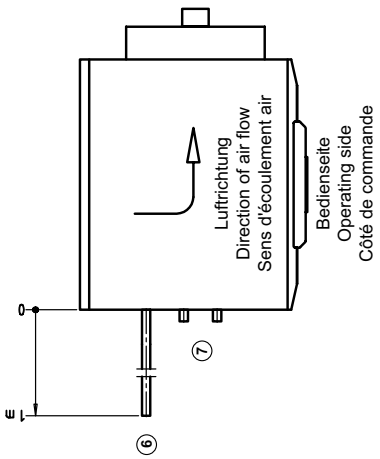
* The dimensions must be increased correspondingly when an insulating strip is used.

2.11.2 Dimensions LI 9TE

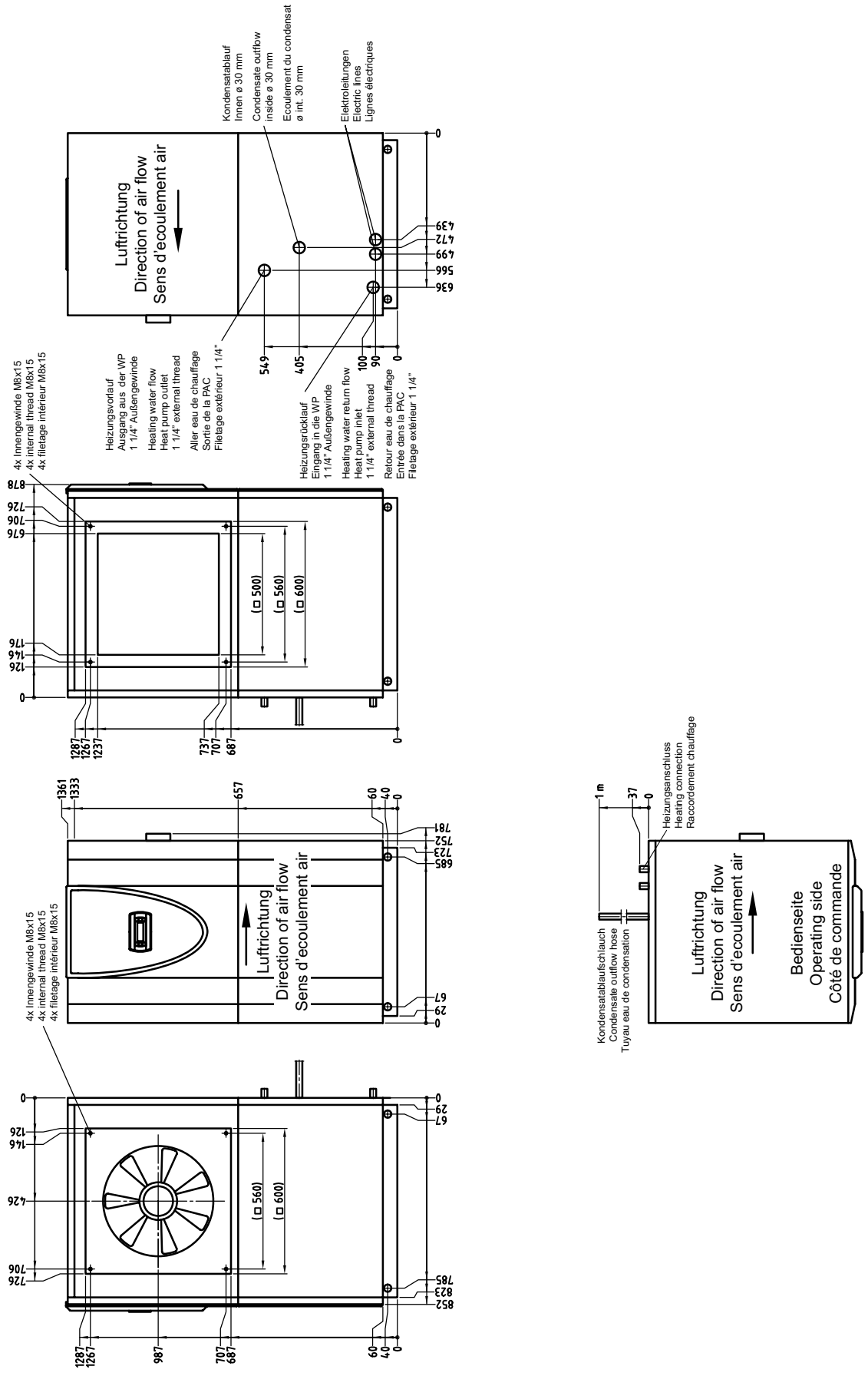


①	4x Innengewinde M8x15	4 x internal thread M8 x 15	4x filetage intérieur M8x15
②	Kondensatablauf Innen ø 30 mm	Condensate outflow inside ø 30 mm	Ecoulement du condensat ø int. 30 mm
③	Elektroleitungen	Electric lines	Lignes électriques
④	Heizungsrücklauf Eingang in die WP 1" Außengewinde	Heating water return flow Heat pump inlet 1" external thread	Retour eau de chauffage Entrée dans la PAC Filetage extérieur 1"
⑤	Heizungsvorlauf Ausgang aus der WP 1" Außengewinde	Heating water flow Heat pump outlet 1" external thread	Aller eau de chauffage Sortie de la PAC Filetage extérieur 1"
⑥	Kondensatablaufschlauch	Condensate outflow hose	Tuyau eau de condensation
⑦	Wasseranschlüsse	Water connections	Raccordements eau

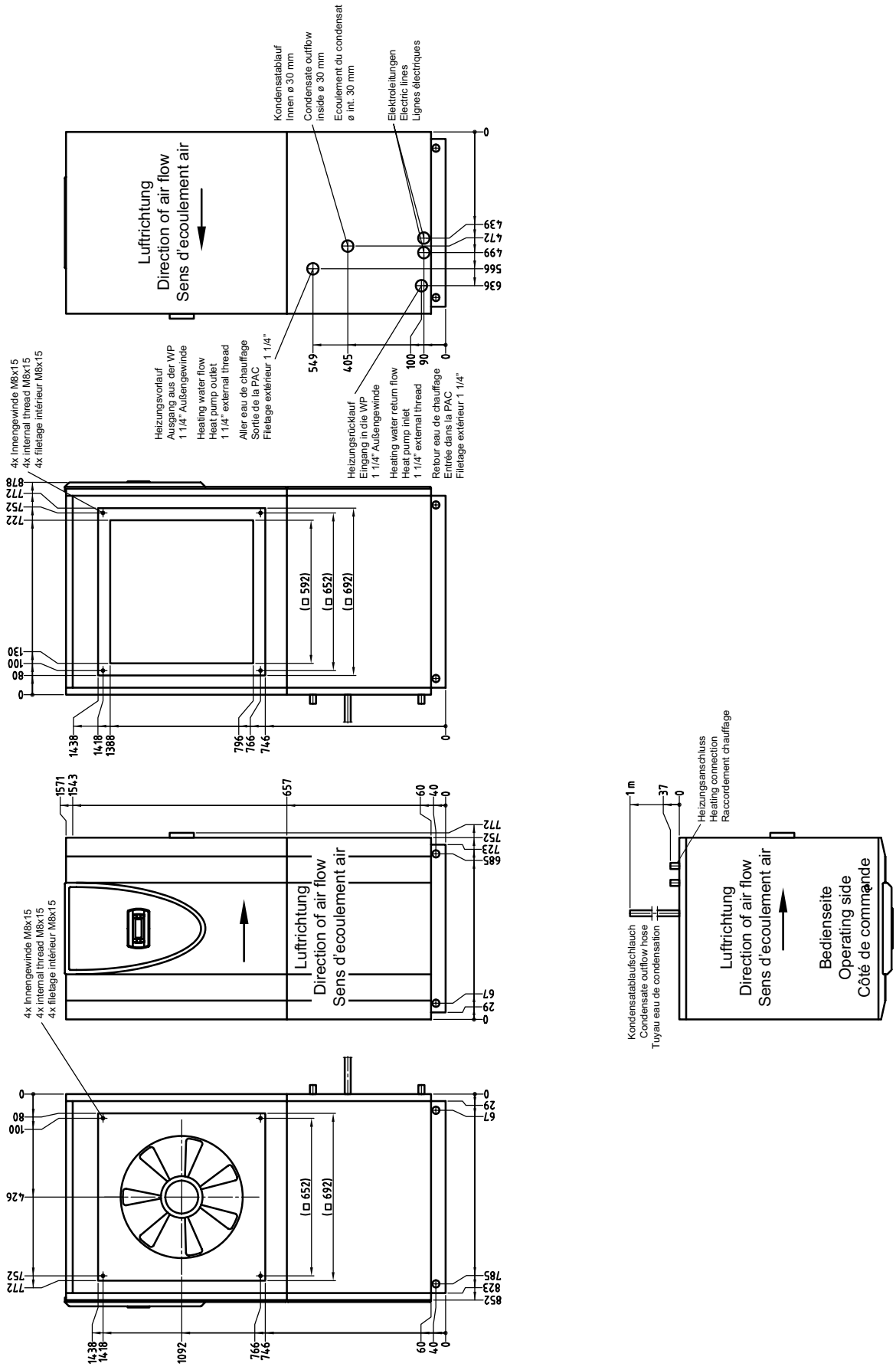




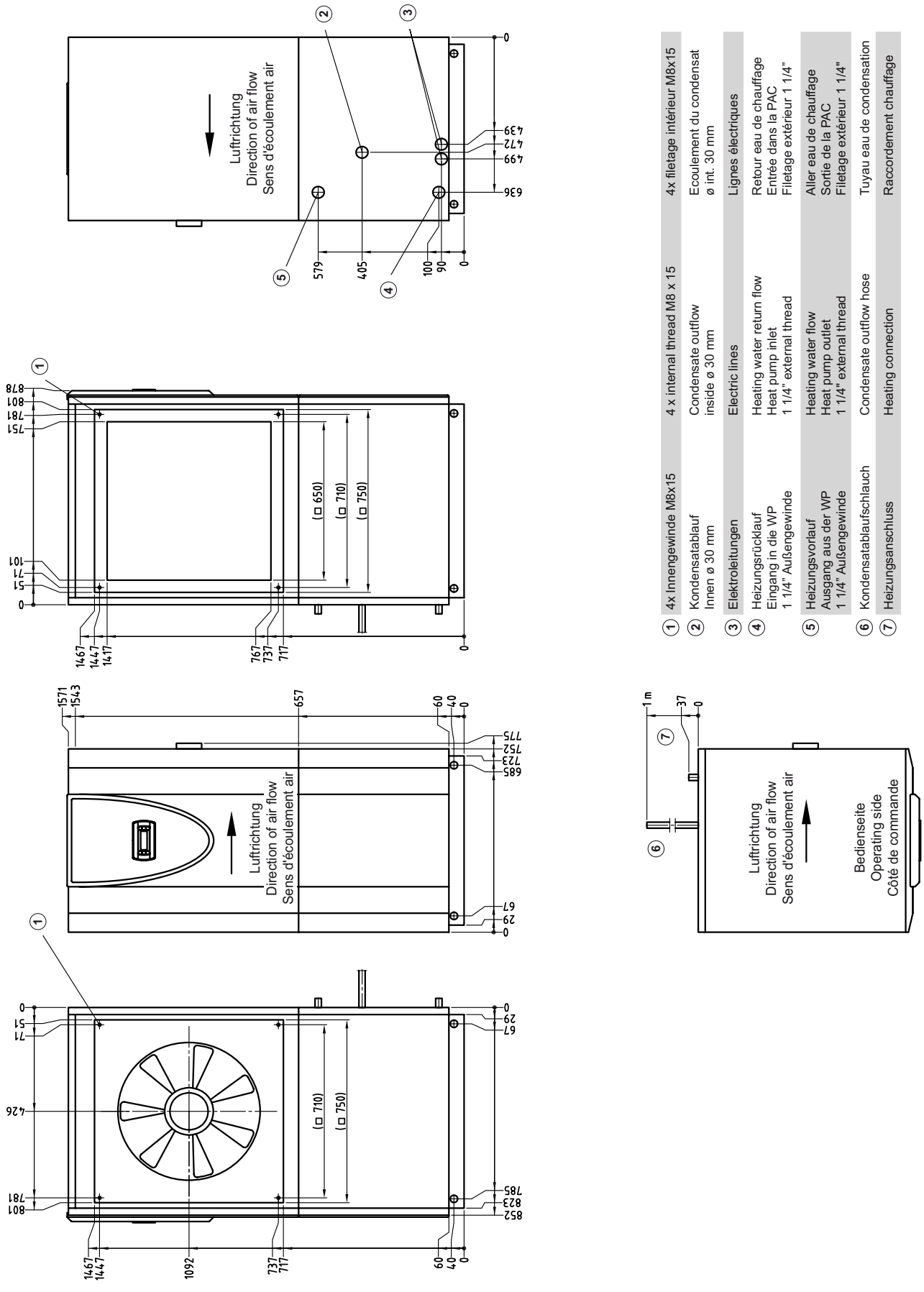
2.11.3 Dimensions LI 11ME / LI 11TE



2.11.4 Dimensions LI 16TE

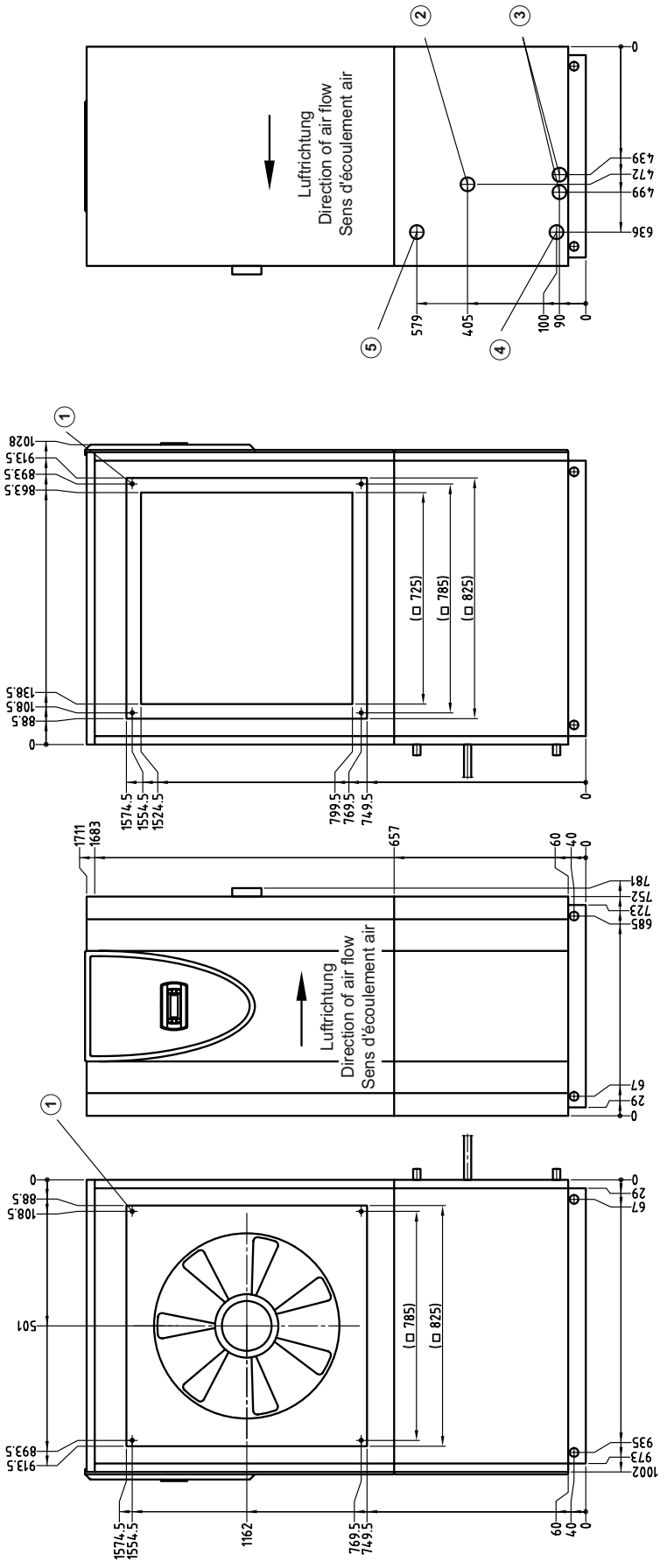


2.11.5 Dimensions LI 20TE

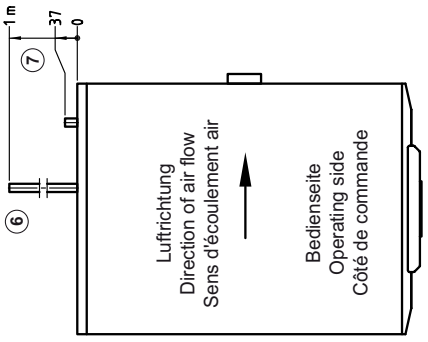


①	4x Innengewinde M8x15	4 x internal thread M8 x 15	4x filetage intérieur M8x15
②	Kondensatablauf Innen ø 30 mm	Condensate outflow inside ø 30 mm	Ecoulement du condensat ø int. 30 mm
③	Elektroleitungen	Electric lines	Lignes électriques
④	Heizungsrücklauf Eingang in die WP 1 1/4" Außengewinde	Heating water return flow Heat pump inlet 1 1/4" external thread	Retour eau de chauffage Entrée dans la PAC Filetage extérieur 1 1/4"
⑤	Heizungsvorlauf Ausgang aus der WP 1 1/4" Außengewinde	Heating water flow Heat pump outlet 1 1/4" external thread	Aller eau de chauffage Sortie de la PAC Filetage extérieur 1 1/4"
⑥	Kondensatablaufschlauch	Condensate outflow hose	Tuyau eau de condensation
⑦	Heizungsanschluss	Heating connection	Raccordement chauffage

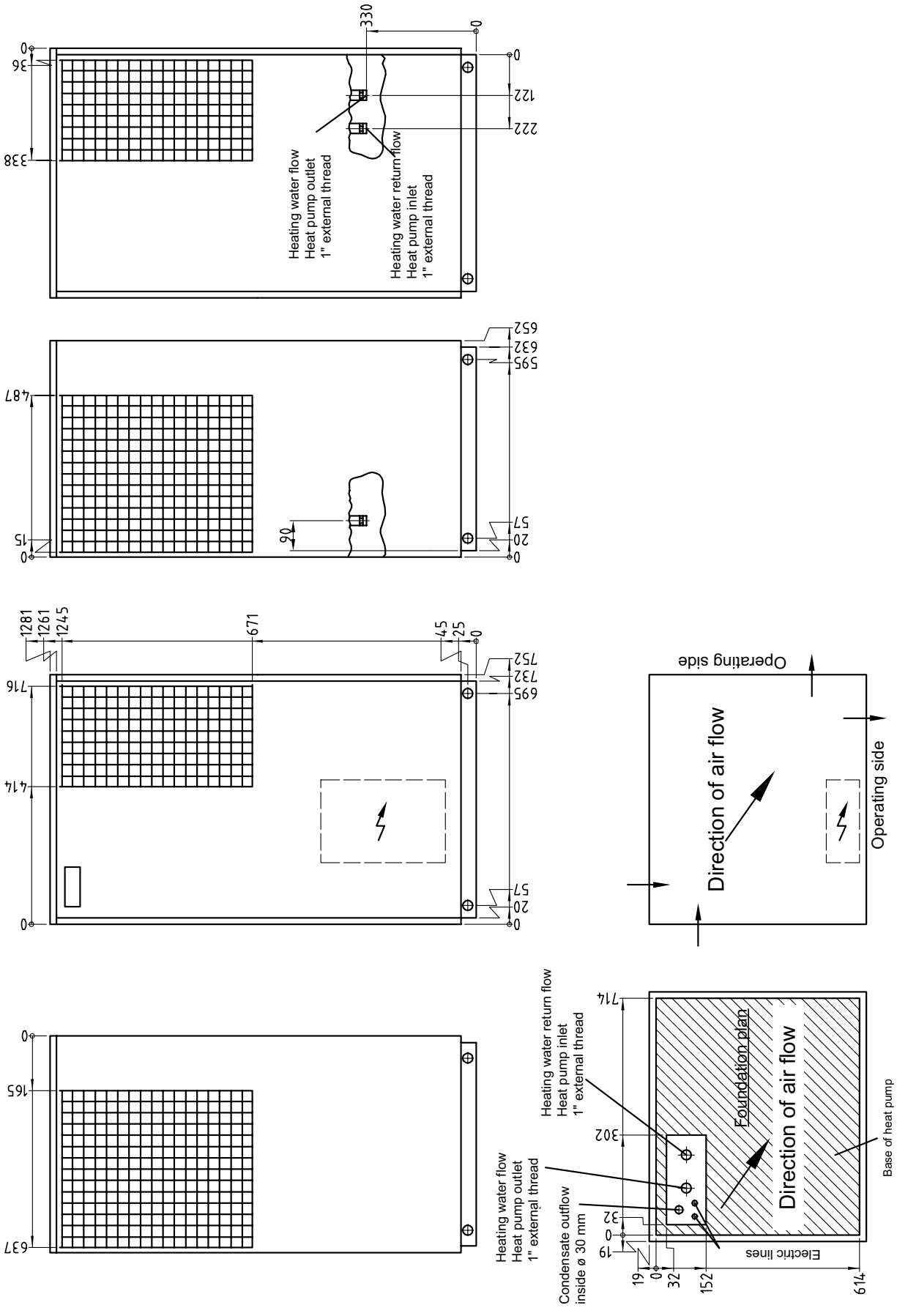
2.11.6 Dimensions LI 24TE / LI 28TE / LIH 22TE / LIH 26TE



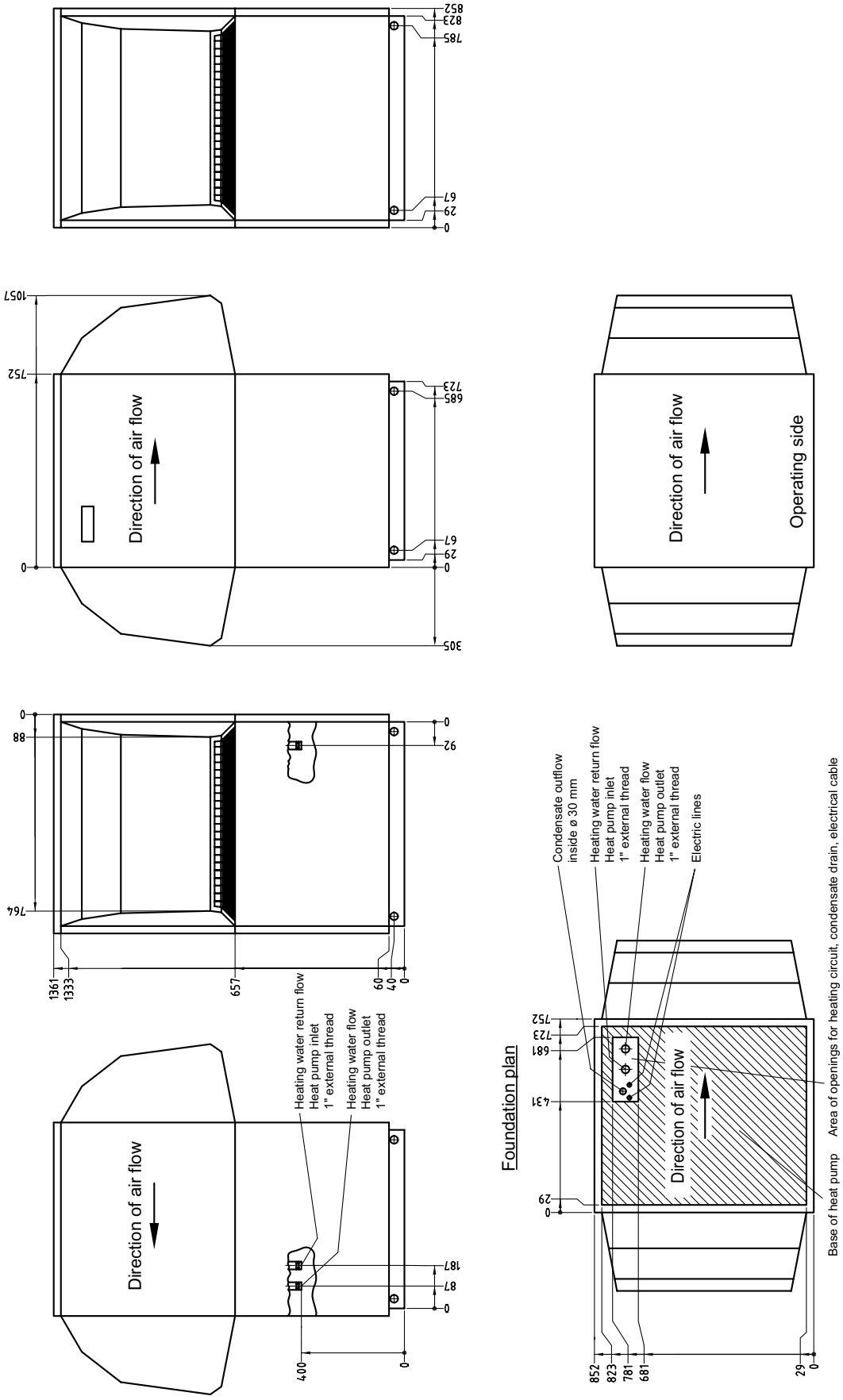
①	4x Innengewinde M8x15	4x filetage intérieur M8x15
②	Kondensatablauf Innen ø 30 mm	Ecoulement du condensat ø int. 30 mm
③	Elektroleitungen	Lignes électriques
④	Heizungsrücklauf Eingang in die WP 1 1/4" Außengewinde	Retour eau de chauffage Entrée dans la PAC Filetage extérieur 1 1/4"
⑤	Heizungsvorlauf Ausgang aus der WP 1 1/4" Außengewinde	Aller eau de chauffage Sortie de la PAC Filetage extérieur 1 1/4"
⑥	Kondensatablaufschlauch	Tuyau eau de condensation
⑦	Heizungsanschluss	Raccordement chauffage



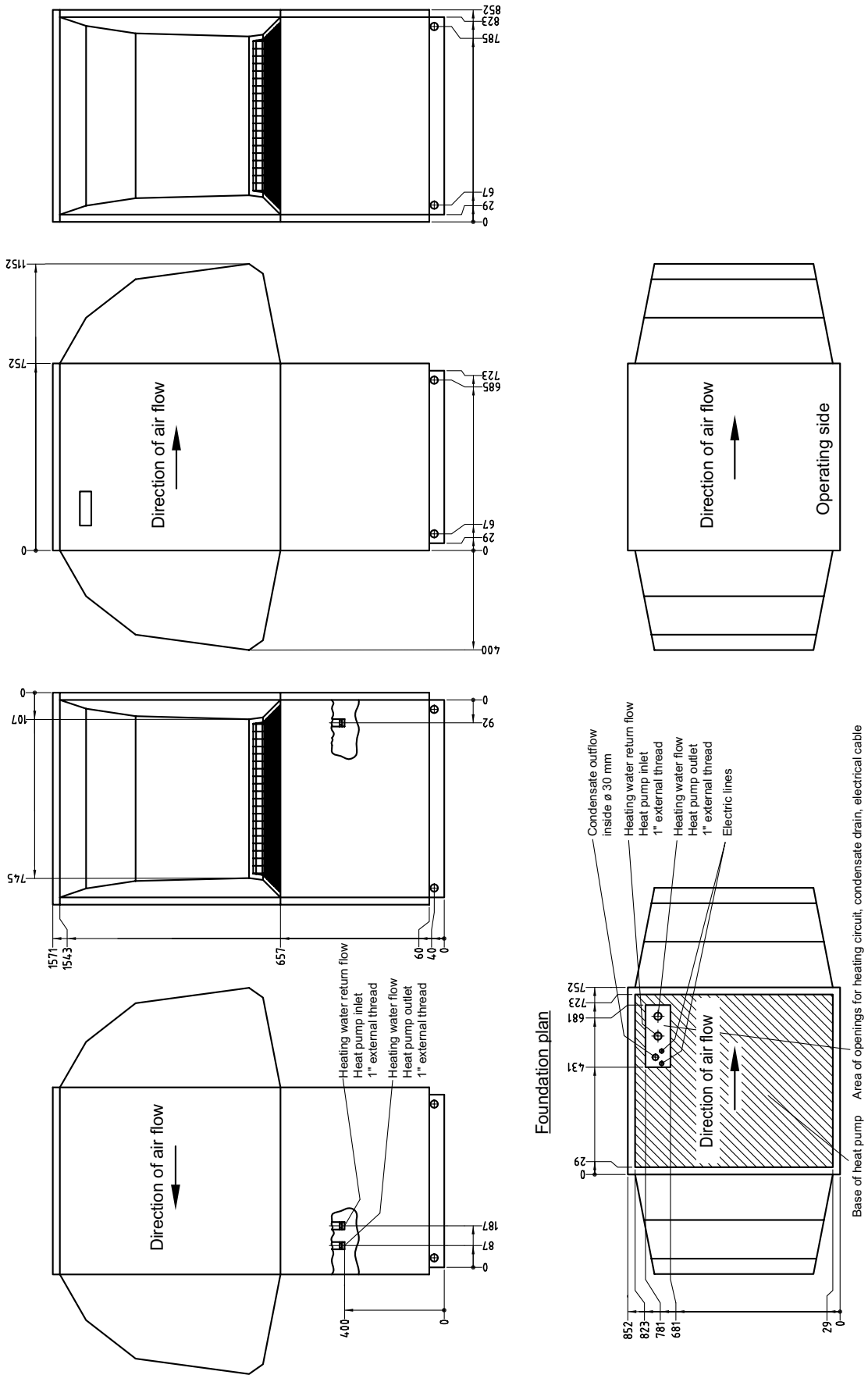
2.11.7 Dimensions LA 8AS



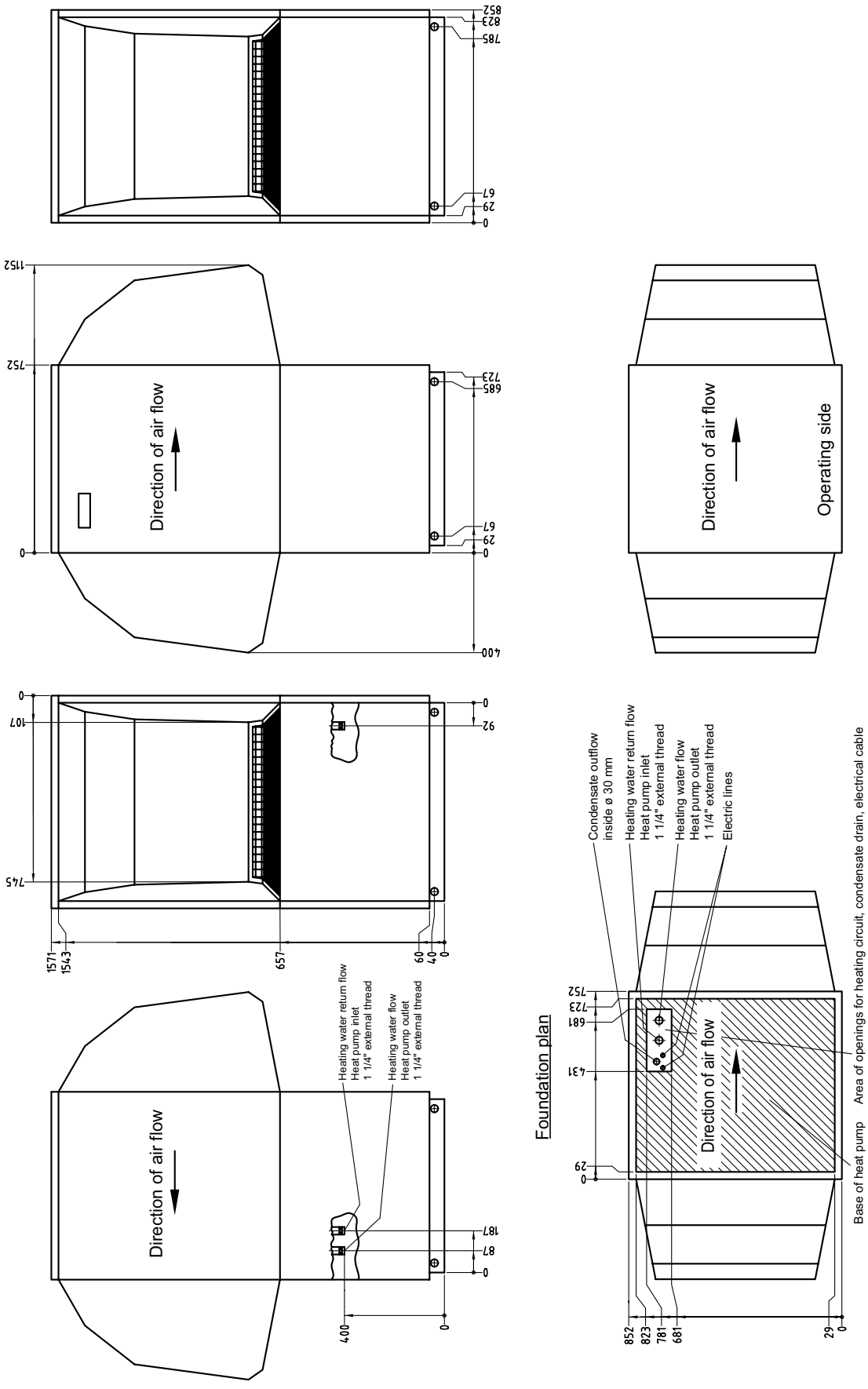
2.11.8 Dimensions LA 11MS / LA 11AS



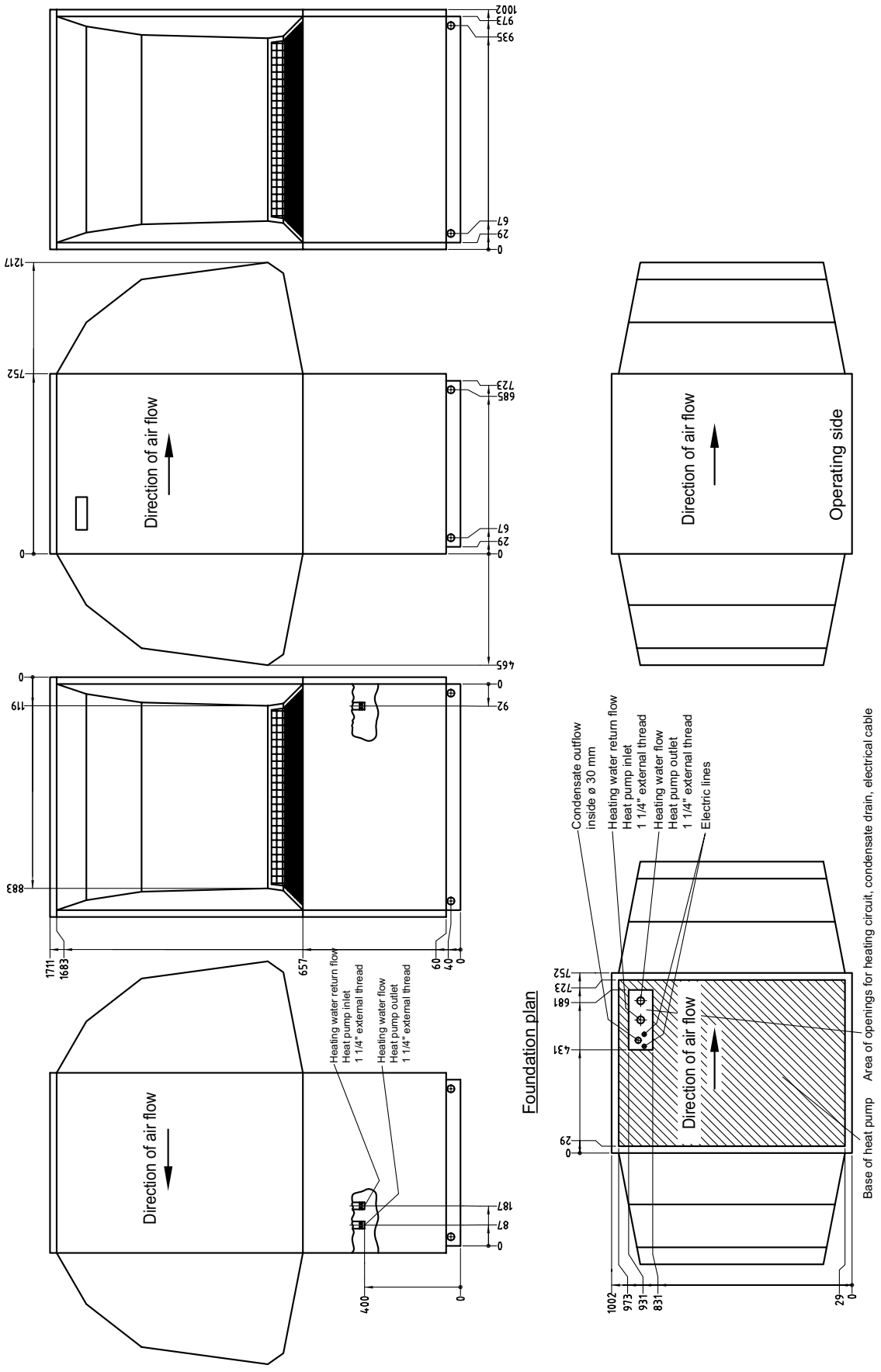
2.11.9 Dimensions LA 16MS / LA 16AS / LA 11PS



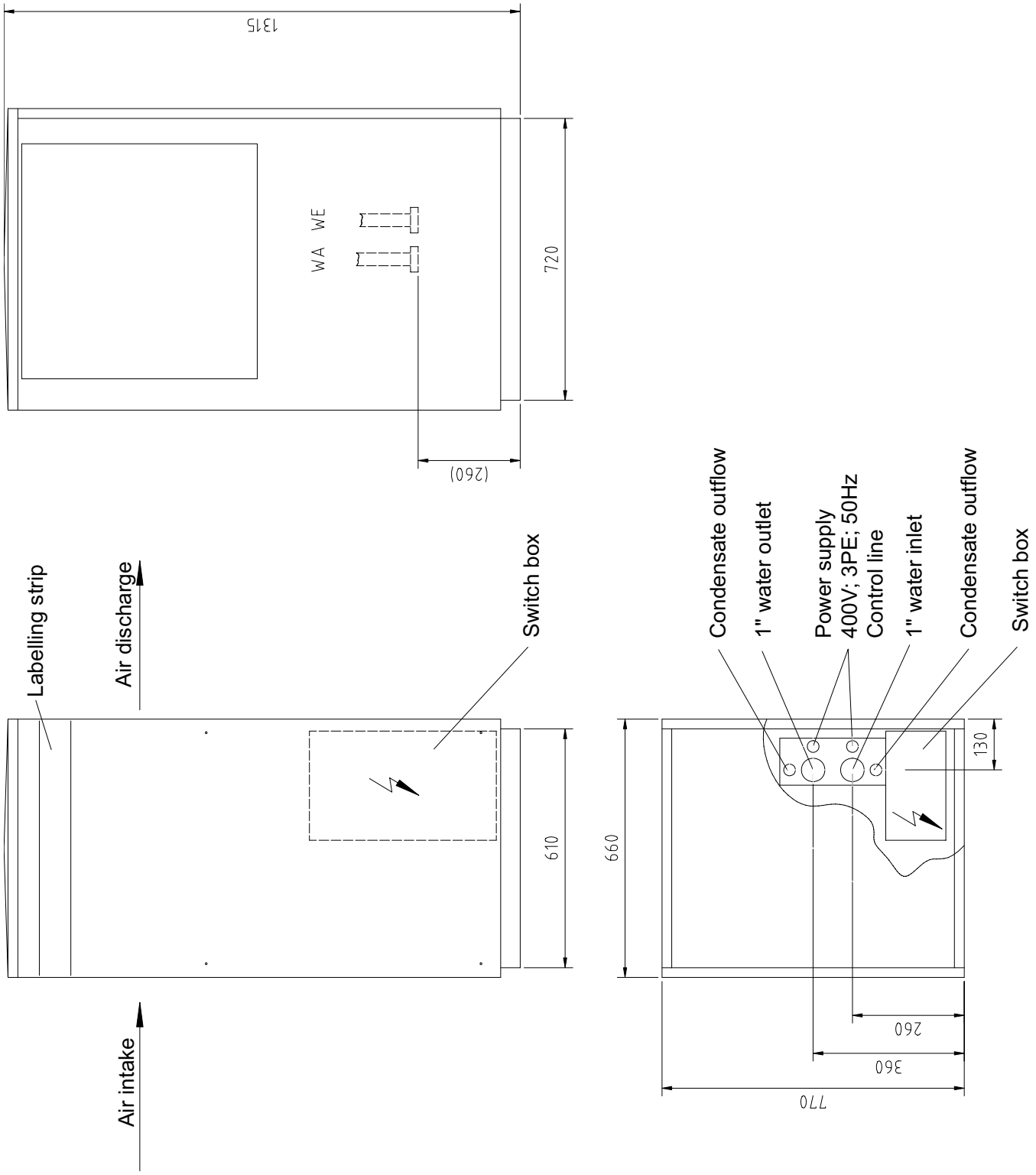
2.11.10 Dimensions LA 20AS / LA 17PS



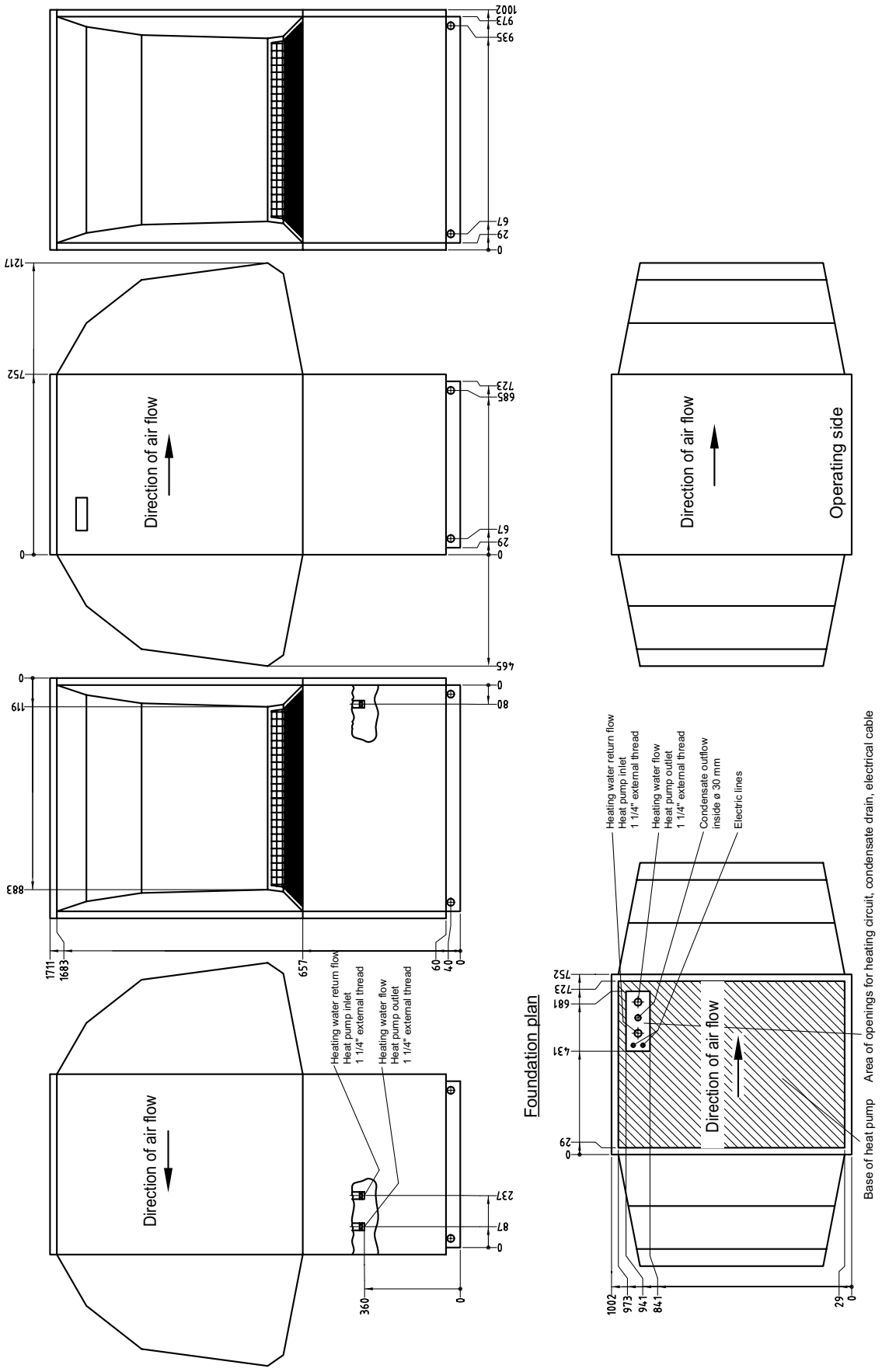
2.11.11 Dimensions LA 24AS / LA 28AS / LA 22PS / LA 26PS


Direction of air flow
Operating side
Foundation plan
Condensate outflow inside ø 30 mm
Heating water return flow
Heat pump inlet 1 1/4" external thread
Heating water flow
Heat pump outlet 1 1/4" external thread
Electric lines
Area of openings for heating circuit, condensate drain, electrical cable
Base of heat pump

2.11.12 Dimensions LA 9PS



2.11.13 Dimensions LA 22HS / LA 26HS



2.12 Acoustic Emissions of Heat Pumps Installed Outdoors

Fig. 2.17 on p. 71 shows the four main directions of sound propagation. The air inlet side is indicated by direction “1” and the air outlet side by direction “3”. Directional sound pressure levels of the air-to-water heat pumps can be determined using *Table 2.8 on p. 71*. The values at a distance of 1 m are actual measured values. The values at a distance of 5 and 10 m are calculated on the basis of hemispherical propagation in the open air. Deviations are possible in actual use on account of sound reflection and/or sound absorption due to local conditions.

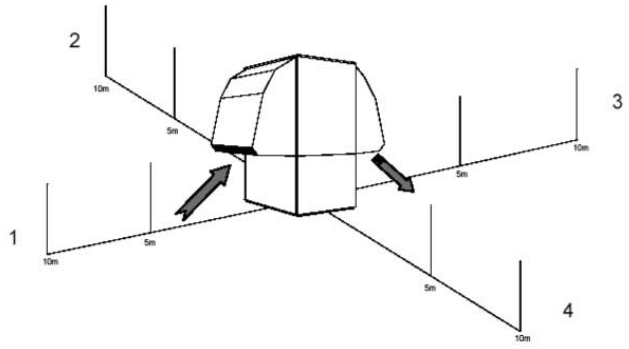


Fig. 2.17: Determination of sound directions

NOTE

Basic principles of sound can be found in *Chap. 5 on p. 144*.

Type	LA 11MS / LA 11AS				LA 16MS / LA 16AS / LA 11PS			
Dir.	1	2	3	4	1	2	3	4
1 m	49	46	50	46	50	47	51	47
5 m	38	35	39	35	39	36	40	36
10 m	32	29	33	29	33	30	34	30

Type	LA 20AS / LA 17PS				LA 24AS / LA 28AS			
Dir.	1	2	3	4	1	2	3	4
1 m	52	48	54	48	56	50	58	50
5 m	41	37	43	37	45	39	47	39
10 m	35	31	37	31	39	33	41	33

Type	LA 22PS / LA 26PS LA 22HS / LA 26HS				LA 8AS / LA 9PS			
Dir.	1	2	3	4	1	2	3	4
1 m	56	50	58	50	49	49	49	49
5 m	45	39	47	39	38	38	38	38
10 m	39	33	41	33	32	32	32	32

Table 2.8: Directional sound pressure level in relation to distance, in dB(A).

For example:

Sound pressure level LA 11AS in the direction of the air outlet at a distance of 10 m: 33 db(A)

3 Brine-to-Water Heat Pump

3.1 Ground as Heat Source

Temperature range of the earth's surface at a depth of approx. 1 m +3 to +17 °C

Temperature range at greater depths (approx. 15 m) +8 to +12 °C

Operating range of the brine-to-water heat pump -5 to +25 °C

Types of operation

- Monovalent
- Mono energy
- Bivalent (alternative, parallel)
- Bivalent-renewable
- Wall penetration

NOTE

Information for using waste heat from cooling water as a heat source can be found in *Chap. 4.3.2 on p. 129*.

3.1.1 Dimensioning information - the ground as heat source

The ground heat exchanger, which serves as a heat source for the brine-to-water heat pump, should be designed according to the cooling capacity of the heat pump. This can be calculated using the heat output minus the electric power consumption of the heat pump as calculated in the design.

$\dot{Q}_0$ = $\dot{Q}_{HP} - P_{el}$

$\dot{Q}_{HP}$ = Heat output of the heat pump

P_{el} = Electr. power consumption of the heat pump as calculated in the design

$\dot{Q}_0$ = Refrigerating or abstraction capacity of the heat pump from the ground as calculated in the design

NOTE

A heat pump with a higher COP has, at comparable heat output, less electrical power consumption and, therefore, higher cooling capacity.

When replacing an older heat pump with a newer model, check the capacity of the collector and, if necessary, modify it to suit the new cooling capacity.

Under ground, heat is conveyed almost solely by thermal conduction, whereby the thermal conductivity increases with increasing water content. Like the thermal conductivity, the heat storage capacity is also largely determined by the water content of the ground. If the water in the ground is frozen, the amount of energy which can be extracted increases considerably because the latent heat of water at approx. 0.09 kWh/kg is very high. Therefore, optimal utilisation of the ground as a heat source is not impaired if the buried pipe coils freeze.

Dimensioning of the brine circulating pump

The volume flow rate of brine depends upon the output of the heat pump and is conveyed by the brine circulating pump. The brine flow rate specified in the device information (*Chap. 3.6 on p. 83*) results in a heat source temperature spread of approx. 3 K.

In addition to the volume flow rate, the pressure drops in the brine circulation system and the technical data of the pump manufacturer should also be taken into consideration. The pressure drops in pipes connected in series, installed components and the heat exchangers should be added.

NOTE

The pressure drop of an antifreeze/water mixture (25 %) is 1.5 or 1.7 times higher than pure water (*Fig. 3.2 on p. 73*), whereas the capacity of many circulating pumps sinks by approx. 10 %.

3.1.2 Drying-out of buildings

When a house is being built, large quantities of water are normally used for mortar, rendering, plaster and wall paper, which only evaporates very slowly from the building. In addition, rain can further increase the humidity in the building's structure. This increased humidity in the entire structure causes an increase in the heat consumption of the house during the first two heating periods.

For this reason, buildings should be dried out using specially designed dehumidifiers. If the heat outputs of the heat pump have been marginally calculated and the respective building is to be dried out in autumn or in winter, particularly if brine-to-water heat pumps are implemented, we recommend installing an additional heating element to compensate for increased heat consumption. This should then only be activated during the first heating period, depending upon the brine flow temperature (approx. 0 °C).

NOTE

In the case of brine-to-water heat pumps, the increased runtimes could cause the heat source to supercool in turn causing the heat pump to automatically switch off.

3.1.3 Brine fluid

Brine concentration

Antifreeze should be added to the water on the heat source side to prevent frost damage to the evaporator of the heat pump. Frost protection is required between -14 °C and -18 °C for pipe coils buried underground, due to the temperatures that may occur in the refrigerating cycle. A monoethylene glycol-based antifreeze is used. The brine concentration for installation underground ranges from 25 % to a maximum of 30 %.

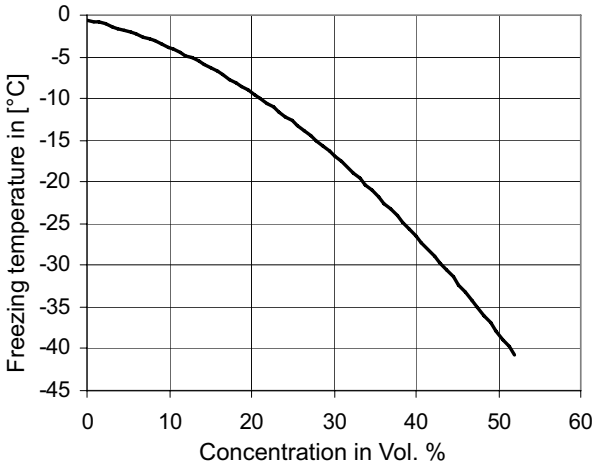


Fig. 3.1: Freezing curve of a monoethylene glycol/water mixture in relation to the concentration

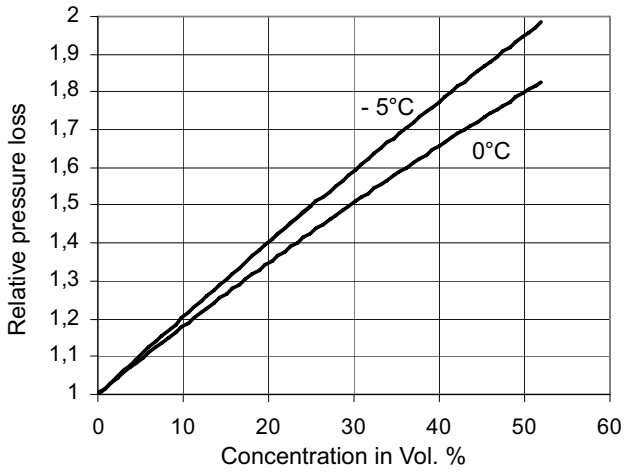


Fig. 3.2: Relative pressure drop of a monoethylene glycol / water mixture compared with water, dependent upon the concentration at 0 °C and –5 °C

Pressure protection

Brine temperatures between approx. -5°C and +20°C can occur when heat is exclusively extracted from the ground. These fluctuations in temperature result in a change in volume of approx. 0.8 to 1% of the total volume of the system. In order to keep the operating pressure constant, an expansion vessel with an admission pressure of 0.5bar and a maximum operating pressure of 3bar is necessary.

⚠ ATTENTION!

For protection against overflowing, a tested membrane safety valve should be installed. The air outlet pipe of the safety valve must, according to DIN EN 12828, end in a collection tank. To monitor pressure, a pressure gauge with minimum and maximum pressure designation is necessary.

Filling the system

The system should always be filled in the following order.

- Mix the required concentration of antifreeze and water in a container.
- Check the antifreeze/water concentration with an antifreeze tester for ethylene glycol.
- Fill the brine circuit (at least 2bar to a maximum of 2.5bar)
- De-aerate the system (install a micro-bubble separator)

⚠ ATTENTION!

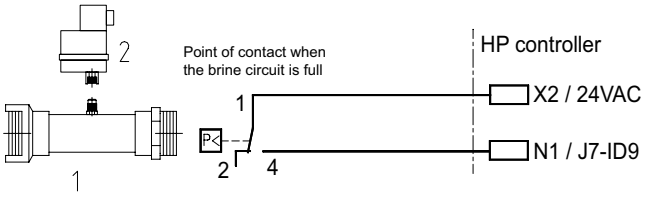
Even following lengthy operation of the brine circulating pump, filling the brine circuit with water and then adding antifreeze does not create a homogenous mixture. The unmixed water column freezes in the evaporator and destroys the heat pump!

Relative pressure drop

The pressure drop of brine is dependent on the temperature and the mixture. The pressure drop of the brine increases with sinking temperatures and increased concentrates of monoethylene glycol.

Insufficient brine solution and leakage

A "low-pressure controller" (available as an accessory) can be installed in the brine circuit to diagnose a lack of fluid, a leakage in the brine circuit and to comply with the regulations of the local authorities. In the event of a drop in pressure, the low-pressure controller sends a signal to the heat pump manager, which is then either indicated in the display or blocks the heat pump.



1) Section of pipe with internal and external threads
2) Pressure controller with connector and connector seal

Fig. 3.3: Low-pressure controller for the brine circuit (assembly and wiring)

Pipe DIN 8074 (PN 12.5) [mm]	Volume per 100 m [l]	Antifreeze per 100m [l]	Maximum brine flow rate [l/h]
25 x 2.3	32.7	8.2	1100
32 × 2.9	53.1	13.3	1800
40 × 3.7	83.5	20.9	2900
50 × 4.6	130.7	32.7	4700
63 × 5.8	207.5	51.9	7200
75 × 6.9	294.2	73.6	10800
90 × 8.2	425.5	106.4	15500
110 x 10	636	159	23400
125 x 11.4	820	205	29500
140 x 12.7	1031	258	40000
160 x 12.7	1344	336	50000

Table 3.1: Total volume and quantity of antifreeze per 100 m pipe for different types of PE pipe and frost protection down to –14 °C

3.2 Ground Heat Collector

The energy stored in the ground comes almost exclusively from the surface of the earth. Precipitation and solar radiation are the main sources of this energy. Thus, nothing should be built on top of collectors nor should the surface be sealed in. The inflow of heat from the interior of the earth is less than 0.1 W/m^2 and can, therefore, be disregarded.

3.2.1 Installation depth

The ground temperature at a depth of 1m can drop to freezing point even without heat being extracted. The minimum temperature at a depth of 2m is approx. 5 °C. This temperature rises with increasing depth, although the heat flow from the earth's surface decreases. Therefore, it cannot be guaranteed that any ice will thaw in the spring. Thus, the installation depth should be approx. 0.2 to 0.3m beneath the maximum frost line. For most regions, this is between 1.0 and 1.5m.

NOTE

The maximum annually extracted energy is 50 to 70 kWh/m^2, which is very difficult to realise in practice due to high costs.

ATTENTION!

For installing ground collectors in trenches, a surface depth of 1.25m should not be exceeded in order to ensure lateral protection.

3.2.2 Installation clearance

When determining the clearance d_a between pipe runs, ensure that the ice radii which form around the pipe coils have melted sufficiently to allow precipitation to drain, thus preventing waterlogging.
The recommended installation clearance is between 0.5 and 0.8 m, depending upon ground conditions and pipe diameter.

- The longer the maximum duration of the frost period, the greater the installation clearance should be.
- In the case of poor ground thermal conduction (i.e. sand), the installation clearance should be reduced (with a comparable horizontal surface), thereby increasing the total pipe lengths.

NOTE

For climate conditions in Germany, an installation clearance of 0.8m has proven successful for damp, cohesive ground (see *Chap. 3.2.6 on p. 76.*

3.2.3 Collector surface and pipe length

The area required for a horizontally-installed ground collector depends upon the following factors:

- Cooling capacity of the heat pump
- Operating hours of the heat pump during heating period
- Ground type and ground humidity content
- Maximum duration of the frost period

NOTE

***Chap. 3.2.6 on p. 76* indicates standard values for dimensioning of ground heat collectors.**

1. Step: Heat consumption of the heat pump as calculated in the design (z.B. B0/W35)

2. Step: Calculation of the cooling capacity by deducting the electric power consumption in the design of the heat output.

$\dot{Q}_0$	=	$\dot{Q}_{HP} - P_{el}$	**Example: SI 14TE**
$\dot{Q}_{HP}$	=	**Heat output of the heat pump**	**14.5 kW**
P_{el}	=	**Electr. power consumption of the heat pump as calculated in the design**	**3.22 kW**
$\dot{Q}_0$	=	**Refrigerating or abstraction capacity of the heat pump from the ground as calculated in the design**	**11.28 kW**

3. Step: Calculate operating hours of the heat pump per year

In Germany, approx.1,800 operating hours for heating and domestic hot water preparation with monovalent heat pump systems is the norm. . In bivalent and mono energy systems, the operating hours increase to approx. 2,400 (depending on the position of the bivalence point).

4. Step: Select specific abstraction capacity depending upon the ground type and expected annual operating hours according to VDI 4640

Ground type	Specific abstraction capacity	
	for 1,800 h	**for 2,400 h**
Dry, non-cohesive ground (sand)	approx. 10 W/m^2	approx. 8 W/m^2
Cohesive ground, damp	approx. 25 W/m^2	approx. 20 W/m^2
Saturated ground (sand, gravel)	approx. 40 W/m^2	approx. 32 W/m^2

Table 3.2: Specific abstraction capacities according to VDI 4640. with an installation clearance of 0.8m

5. Step: The collector surface is obtained from the cooling capacity and the specific abstraction capacity

$\dot{Q}_0$	=	**Cooling capacity of the heat pump**	**11.28 kW**
$\dot{q}$	=	**Specific abstraction capacity of the ground**	**25 W/m^2**
A	=	**Collector surface**	**451m^2**
		Minimum pipe length for an installation clearance of 0.8m	**564 m**
		Number of brine circuits á 100m	**6**

PE pipe is available in standard 100m lengths. Thus, a 564m minimum pipe length results in 6 circuits á 100 and a horizontal surface of 480m².

NOTE

The calculated minimum pipe length is, in practice, rounded up to a full 100m circuit.

3.2.4 Installation

The pipe coils should be connected and laid using a flow manifold and return flow collector according to the following figure, so that all brine circuits are of equal length.

NOTE

When installing brine circuits of equal length, hydraulic equalization is not necessary.

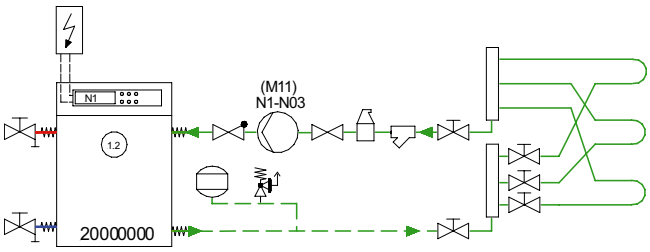


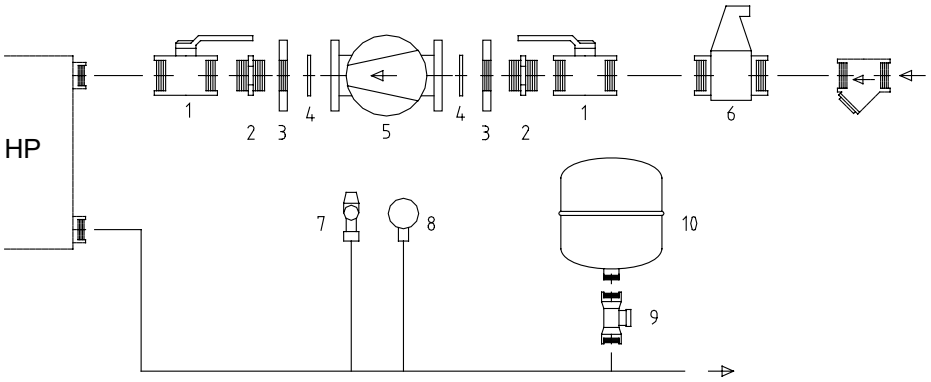
Fig. 3.4: Hydraulic integration of the brine circuits

3.2.5 Installation of the brine circuit

- Every brine circuit should be provided with at least one shutoff valve.
- Brine circuits must all be of the same length to ensure that each has an equal flow and abstraction capacity.
- Ground heat collectors should preferably be installed some months before the start of the heating season to allow the earth to settle.
- The minimum bend radii as stipulated by the pipe manufacturer should be observed.
- The filling and ventilation system should be installated at the site's highest point.
- All the brine circuit pipes that run through the walls of the house should be insulated with steam-resistant material to prevent the formation of condensation.
- All brine-bearing pipes must be made of corrosion-resistant material.
- The brine circuit manifold and the return flow collector must be installed outside the house.
- The brine circulating pump of the heat source system should preferably also be installed outside the building. When installing inside a building, the pump should be insulated with steam-resistant material to prevent the formation of condensation and ice. Sound insulating measures may also be necessary.
- The installation clearance between brine-bearing pipes and water pipes, sewers and buildings should be at least 0,7 m to prevent frost damage. If this clearance cannot be ensured due to constructional reasons, the pipes should be sufficiently insulated in the affected area.
- Nothing should be built on top of ground heat collectors, nor should the surface be sealed in.

NOTE

If the brine circulating pump is installed outdoors, steam-resistant insulation to protect against condensation is not required.



Legend

1) Ball valve
2) Double nipple
3) Flange
4) Flange seal
5) Circulating pump
6) Main breather
7) Pressure relief valve
8) Pressure gauge
9) Cap valve $^{3}/_{4}$“
10) Expansion vessel

Fig. 3.5: Set-up of the brine circuit inlet pipe including baffles

The main breather with micro-bubble separator should be positioned at the highest and warmest point in the brine circuit. The equipment for the brine circuit can be installed either inside or outside the building.

NOTE

The dirt trap included in the scope of supply of the heat pump (mesh size 0.6 mm) protects the evaporator of the heat pump; it should be installed in the heat pump inflow and be cleaned after a brine circulating pump flush cycle of approx. 1 day.

NOTE

Insulating materials that do not absorb any moisture should be used to prevent the insulation from becoming soaked. The joints should also be glued so that no moisture can penetrate through to the cold side (e.g. brine pipe) of the insulation.

3.2.6 Standard dimensions of ground heat collectors.

The data in the dimensioning table *Table 3.3 on p. 77* is based on the following assumptions:

- PE pipe (brine circuit): pipe DIN 8074
  32 x 2.9 mm – PE 80 (PN 12.5)
- PE feeder pipe between the heat pump and the brine circuit according to DIN 8074:
- Nominal pressure PN 12.5 (12.5 bar)
- Specific abstraction capacity of the ground 25 W/m^2
- Brine concentration: minimum 25% to maximum 30% antifreeze (glycol-based)
- Pressure expansion vessel: 0.5 bar admission pressure

NOTE

The dimensioning of the brine circulating pump is only valid for lengths of up to a maximum of 100 m and the given number of brine circuits!

An increase in the number of brine circuits and a reduction in the run lengths does not have a critical affect on the pressure drops if all other parameters remain the unchanged. For varying framework conditions (e.g. the specific abstraction capacity, brine concentration), the total permissible pipe length for the flow and return flow between the heat pump and the brine circuit manifold must be dimensioned again.

The quantity of antifreeze listed in *Table 3.1 on p. 73* is based upon the given wall thicknesses. The amount of antifreeze should be increased for smaller wall thicknesses to maintain the minimum brine concentration of 25%.

Heat pump	Circulating pump same type of model or similar	Designation of the circulating pump	Alternative Grundfos	Minimum brine flow rate	Cooling capacity	Pipe length of the ground heat collector[1]	Number of brine circuits	Pressure expansion vessel	Permissible total pipe lengths for flow and return flow between the heat pump and brine circuit manifold									Motor prot.
									32 x 2.9	40 x 3.7	50 x 4.6	63 x 5.7	75 x 6.8	90 x 8.2	110 x 10	125 x 11.4	140 x 12.7	
				m^3/h	kW	m		l	m	m	m	m	m	m	m	m	m	A
SI 5ME	Wilo	TOP-S 25/7.5	UPS 25-60	1.2	3.7	200	2	8	50									2
SI 5TE	Wilo	TOP-S 25/7.5	UPS 25-60	1.2	4.1	200	2	8	50									2
SI 7ME	Wilo	TOP-S 25/7.5	UPS 25-60	1.7	4.7	300	3	8	15	40	110							2
SIK 7TE / SI 7TE	Wilo	TOP-S 25/7.5	UPS 25-60	1.7	5.3	300	3	8	15	40	110							2
SI 9ME	Wilo	TOP-S 25/7.5	UPS 25-80	2.3	6.9	400	4	12		20	65							2
SIK 9TE / SI 9TE	Wilo	TOP-S 25/7.5	UPS 25-80	2.3	7.1	400	4	12		20	65							2
SIK 11ME	Wilo	TOP-S 25/7.5	UPS 25-80	3	9.1	500	5	12		10	70							2
SI 11ME	Wilo	TOP-S 25/7.5	UPS 25-80	3	8.3	500	5	12		10	70							2
SIK 11TE / SI 11TE	Wilo	TOP-S 25/7.5	UPS 25-80	3	9.1	500	5	12		10	70							2
SI 14ME	Wilo	TOP-S 25/7.5	UPS 25-80	3.5	10.9	600	6	18			20	70						2
SIK 14TE / SI 14TE	Wilo	TOP-S 25/7.5	UPS 25-80	3.5	11.3	600	6	18			20	70						2
SIK 16ME	Wilo	TOP-S 25/7.5	UPS 25-80	3..5	11.3	700	7	18			20	70						2
SI 17TE	Wilo	TOP-S30/10	UPS 32-80	3.8	13.4	700	7	18			60	180						2
SI 21TE	Grundfos	CHI4-20		5.5	16.2	900	9	18			80	270						1.1
SIH 20TE	Wilo	TOP-S 40/10		5.1	17.5	900	9	18			100	300						1.2
SI 24TE	Wilo	TOP-S 40/10		5.6	18.4	1000	10	18			100	300						1.2
SI 37TE	Wilo	TOP-S 40/10		8.5	29.3	1500	15	18				120	350					1.2
SIH 40TE	Wilo	TOP-S 40/10		8.5	33.1	1700	17	8				120	350					1.2
SI 50TE	Wilo	TOP-S 50/10		12.8	40	2000	20	25					70	180				1.8
SI 75TE	Wilo	TOP-S 65/13		20.5	63	3100	31	35						120	300			3.0
SI 100TE	Wilo	TOP-S 65/13		24	77	3800	38	50							180	300		3.0
SI 130TE	Wilo	TOP-S 65/15		34	105	5100	52	50								140	300	3.5

1. according to *Chap. 3.2.6 on p. 76*
2. With integrated full motor protection or blocking current-resistant motor

Table 3.3: Dimensioning table for brine-to-water heat pumps for a specific abstraction capacity of the soil of 20 W/m with a ground heat collector. (assumptions: brine concentration with 25 % antifreeze, 100 m pipe run lengths in the individual brine circuits, pipes made of PE 80 (PN12.5), 32 x 2.9 mm according to DIN 8074 and 8075)

3.3 Borehole Heat Exchangers

When implementing a borehole heat exchanger system, a heat exchanger system is constructed in boreholes, usually with a depth of between 20 m to 100 m in the ground. When double U pipes are used, there is an estimated average heat source output of approx. 50 W per drilling metre of loop. However, exact dimensioning depends on the respective geological and hydro-geological conditions, which are generally unknown by the heating technician. Dimensioning should, therefore, be left to a drilling company accredited with the seal of approval from the International Heat Pump Association or authorised according to DVGW W120. In Germany, the information in the Association of German Engineers' (VDI) publication VDI-4640 Parts 1 and 2 should be taken into consideration.

Ground temperatures

The ground temperature below a depth of approx. 15 m is around 10 °C all year round (see *Fig. 3.6 on p. 78*).

NOTE

The extraction of heat causes the temperatures in the pipe to drop. Dimensioning must ensure that no permanent brine outlet temperatures fall below 0 °C.

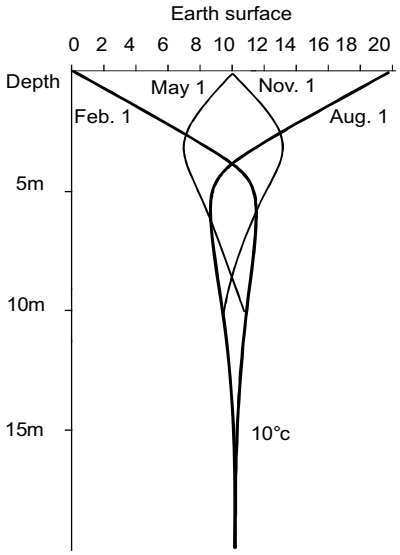


Fig. 3.6: Illustration of the temperature curve at different depths underground in relation to the seasonal, mean temperature values on the earth's surface.

3.3.1 Dimensioning of borehole heat exchangers

For single systems with a heat pump heat output of up to 30 kW (that are installed for heating and DHW preparation), dimensioning can be carried out based on specific abstraction capacities according to *Table 3.4 on p. 78*, which is based on the following assumptions:

- Length of the individual borehole heat exchangers between 40 and 100 m
- At least 6 m clearance between two borehole heat exchangers
- The borehole heat exchangers used are either double U pipes with an individual pipe diameter of DN 32 or DN 40.

These abstraction capacities are permissible for borehole heat exchangers for standard installation with low output. In the case of longer runtimes, both the specific abstraction capacity already mentioned and the annual abstraction factor should also be taken into consideration. This should be between 100 and 150 kWh per drill meter and per year.

For heat pump systems that

- consist of several single systems
- require more than 2,400 operating hours annually
- are installed for both heating and cooling
- are over 30 kW of heat pump total heat output,

the system dimensioning must be approved using calculations from a geothermal planning professional.

Long-term, calculated simulation of low gears allows identification of the long-term effects and, therefore, take these into consideration during dimensioning.

Foundations	Specific abstraction capacity	
	for 1,800 h	for 2,400 h
Standard values:		
Poor subsoil (dry sediment) (λ < 1.5 W/(m * K))	25 W/m	20 W/m
Normal bedrock and saturated		
sediment (λ = 1.5 - 3.0 W/(m * K))	60 W/m	50 W/m
Bedrock with a high thermal conductivity (λ > 3.0 W/m * K))	84 W/m	70 W/m
Types of stone:		
Gravel, sand, dry	< 25 W/m	< 20 W/m
Gravel, sand, aquiferous	65 – 80 W/m	55 - 65 W/m
Gravel and sand with strong ground water current, for single systems	80-100 W/m	80-100 W/m
Clay, loam, damp	35 – 50 W/m	30 - 40 W/m
Limestone (solid)	55 – 70 W/m	45 - 60 W/m
Sandstone	65 – 80 W/m	55 - 65 W/m
Acidic igneous rock (e.g. granite)	65 – 85 W/m	55 - 70 W/m
Alkaline igneous rock (e.g. basalt)	40 – 65 W/m	35 - 55 W/m
Gneiss	70 – 85 W/m	60 - 70 W/m

Table 3.4: Typical specific abstraction capacities for borehole heat exchangers (double U pipes) (according to VDI 4640 Part 2)

3.3.2 Preparation of boreholes

The clearance between the heat exchangers should be at least 6 m so that reciprocal interference is kept to a minimum and regeneration is guaranteed in the summer. If several heat exchangers are required, these should not be laid out parallel to the direction of ground water flow, but transverse to it. (see *Fig. 3.7 on p. 79*).

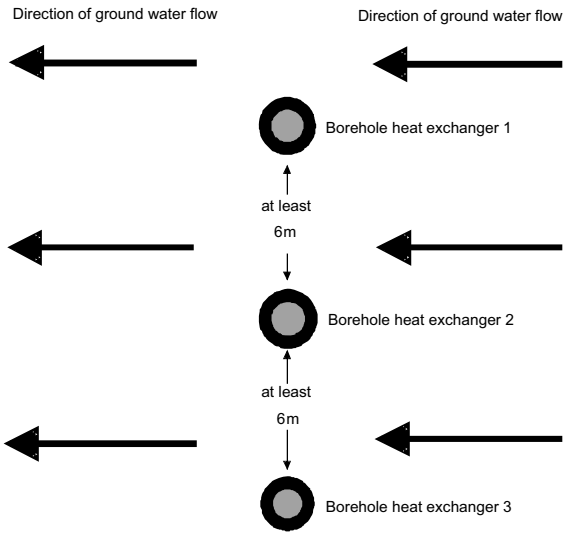


Fig. 3.7: Layout and minimum clearances between borehole heat exchangers in relation to the direction of the ground water current

NOTE

The same rules as for ground heat collector systems apply to brine concentration, materials, layout of the manifold shaft and installation of the pump and expansion vessel.

Fig. 3.8 on p. 79 shows a cross section through a double U pipe of the type normally used for heat pumps.

For this type of heat exchanger pipe, a bore hole must first be drilled with a radius of r_1. Four heat exchanger pipes and a back-fill pipe are inserted, and the hole is then back-filled with a cement/bentonite mixture. The heat exchanger fluid flows downwards in two of the pipes and flows upwards again in the other two. The pipes are connected at the lower end with a borehole head, creating a closed-loop heat exchanger circuit.

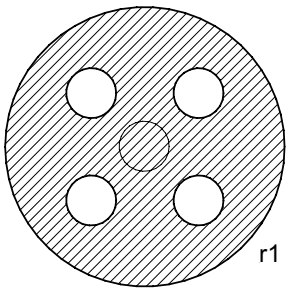


Fig. 3.8: Cross section of a double U pipe with back-fill pipe

NOTE

When using brine equipment or heat pumps with an integrated brine circulating pump, the pressure drops of the borehole heat exchanger must be determined and compared with the free compression of the brine circulating pump. To avoid unnecessarily high pressure drops, DN40 pipes should be used for borehole heat exchanger depths of more than 80 m.

3.3.3 Additional heat source systems for ground heat usage

As an alternative to ground collectors, other types of heat source systems such as ground heat baskets, trench collectors, energy posts, coil collectors, etc. are also possible.
Dimensioning of these heat source systems must proceed according to manufacturer or supplier specifications. The manufacturer must guarantee the long-term functioning of the system based on the following information:

- Minimum permissible brine temperature
- Cooling capacity and brine flow rate of the installed heat pump
- Annual operating hours of the heat pump

Additionally, the following information should be made available:

- Pressure drop with specified brine flow rate for dimensioning the brine circulating pump
- Possible impact on the vegetation
- Installation requirements

Experience shows that the abstraction capacities of classic ground heat collectors only differ slightly from other systems, as the energy stored 1 m^3 in the ground is limited at 50 to 70 kWh/a. Possible optimisation of the abstraction capacities depend first and foremost on the climate conditions and the ground type and not on the type of heat source system.

3.4 Heat Source Absorber Systems (Indirect Use of Air or Solar Energy)

Brine temperature range -15...+ 50 °C

Operating range of the brine-to-water heat pump -5 to +25 °C

Availability

Possible restrictions due to effects of the weather and limited space.

Types of operation

- Bivalent
- Monovalent in combination with an additional ground heat collector

Development costs

- Absorber system (energy roof, pipe bundle, solid absorber, energy fence, energy tower, energy stack, etc.)
- Ethylene glycol or propylene glycol-based brine in a frost-proof concentration
- Pipework and circulating pump
- Construction work

PAY SPECIAL ATTENTION TO:

- Building requirements
- Effects of the weather

Dimensioning absorber systems

Individual constructions vary considerably, so that the factory specifications should normally be consulted when dimensioning roof absorbers, energy towers and energy fences.

Experience has shown that the following data can be used as a basis:

- The absorber surface should be designed according to the specified off-peak (nighttime) output of the absorber.
- Even at temperatures over 0 °C, rain, dew or snow can freeze on the surface of the absorber when the temperature of the brine is very low. This could have a negative effect on the flow rate.
- Monovalent operation is only possible in combination with the utilization of ground source heat.
- With the use of solar energy, brine can reach temperatures of 50 °C or more in the transition period. Such temperatures greatly exceed the operating range of the heat pump.

⚠ ATTENTION!

If the heat source temperature can rise to over 25 °C, then a temperature-controlled mixer is required that, for temperatures over 25 °C, adds the cooling water to a partial volume flow of the cooling water return flow.

Brine concentration

Due to the low outdoor temperatures, frost protection down to –25 °C is necessary for roof absorbers, energy fences, etc. The brine concentration for this system is 40 %. When dimensioning the brine circulating pump, it should be taken into consideration that the higher the brine concentration, the higher the pressure drops.

Filling the system:

The system should be filled as described in *Chap. 3.1.3 on p. 72*.

Design of the expansion vessel:

The brine temperatures vary between approx. –15 °C and approx. +50 ° C for absorber-only operation. An expansion vessel must be installed in the vicinity of the heat source system to accommodate these large temperature fluctuations. The admission pressure should be set to correspond to the height of the system. The maximum overpressure is 2.5 bar.

Air pressure absorber

Brine concentration: ≈ 40%

Relative pressure drop ≈ 1,8

3.5 Device Information for Brine-to-Water Heat Pumps (1-Phase, 230 V AC)

3.5.1 Low-temperature heat pumps in a compact design SIK 11ME to SIK 16ME

Device information for brine-to-water heat pumps for heating purposes					
1	**Type and order code**			SIK 11ME	SIK 16ME
2	**Design**				
2.1	**Design**			Compact	Compact
2.2	**Degree of protection according to EN 60 529**			IP20	IP20
2.3	**Installation location**			Indoors	Indoors
3	**Performance data**				
3.1	**Operating temperature limits:**				
	Heating water flow		**°C**	Up to 55	Up to 55
	Brine (heat source)		**°C**	-5 to +25	-5 to +25
	Antifreeze			Monoethylene glycol	Monoethylene glycol
	Minimum brine concentration (-13 °C freezing temperature)			25%	25%
3.2	**Temperature spread of heating water (flow/return flow) at B0 / W35K**			9.9	10
3.3	**Heat output / COP**	**at B-5 / W55 [1]**	**kW / ---**	9.4 / 2.4	13.3 / 2.2
		at B0 / W50 [1]	**kW / ---**	11.3 / 3.0	15.5 / 2.9
		at B0 / W35 [1]	**kW / ---**	11.8 / 4.4	15.8 / 4.2
3.4	**Sound power level**		**dB(A)**	51	51
3.5	**Heating water flow with an internal pressure differential of m³/h / Pa**			1.0 / 3500	1.3 / 3500
3.6	**Free compression of heat circulating pump (max. level)**		**Pa**	65500	43500
3.7	**Brine flow with an internal pressure differential (heat source) of m³/h / Pa**			3.0 / 13000	3.5 / 13000
3.8	**Free compression of brine circulating pump (max. level)**		**Pa**	40000	34000
3.9	**Refrigerant; total filling weight**		**type / kg**	R407C / 2.0	R407C / 2.3
4	**Dimensions, connections and weight**				
4.1	**Device dimensions without connections [2]**		**H x W x L mm**	1115 × 652 × 688	1115 × 652 × 688
4.2	**Device connections to heating system**		**Inch**	R 1¼" external	R 1¼" external
4.3	**Device connections to heat source**		**Inch**	R 1¼" external	R 1¼" external
4.4	**Weight of the transportable unit(s) incl. packing**		**kg**	191	203
5	**Electrical connection**				
5.1	**Nominal voltage; fuse protection**		**V / A**	230 / 25	230 / 32
5.2	**Nominal power consumption [1]**	**B0 W35**	**kW**	2.66	3.77
5.3	**Starting current with soft starter**		**A**	38	50
5.4	**Nominal current B0 W35 / cos φ**		**A / ---**	14.46 / 0.8	20.5 / 0.8
6	**Complies with the European safety regulations**			[3]	[3]
7	**Additional model features**				
7.1	**Water in device protected against freezing [4]**			Yes	Yes
7.2	**Performance levels**			1	1
7.3	**Controller internal/external**			Internal	Internal

1. This data indicates the size and capacity of the system according to EN 255 or EN 14511. For an analysis of the economic and energy efficiency of the system, the bivalence point and regulation should be taken into consideration. The specified values, e.g. B10 / W55, have the following meaning: Heat source temperature 10 °C and heating water flow temperature 55 °C.
2. Note that additional space is required for pipe connections, operation and maintenance.
3. See CE declaration of conformity
4. The heat circulating pump and the heat pump controller must always be ready for operation.

3.5.2 Low-temperature heat pumps SI 5ME to SI 14ME

Device information for brine-to-water heat pumps for heating purposes								
1	**Type and order code**			SI 5ME	SI 7ME	SI 9ME	SI 11ME	SI 14ME
2	**Design**							
2.1	**Degree of protection according to EN 60 529**			IP20	IP20	IP20	IP20	IP20
2.2	**Installation location**			Indoors	Indoors	Indoors	Indoors	Indoors
3	**Performance data**							
3.1	**Operating temperature limits:**							
	Heating water flow		°C	Up to 55	Up to 55	Up to 55	Up to 55	Up to 55
	Brine (heat source)		°C	-5 to +25	-5 to +25	-5 to +25	-5 to +25	-5 to +25
	Antifreeze			Monoethylene glycol	Monoethylene glycol	Monoethylene glycol	Monoethylene glycol	Monoethylene glycol
	Minimum brine concentration (-13 °C freezing temperature)			25%	25%	25%	25%	25%
3.2	**Temperature spread of heating water (flow/return flow) at B0 / W35K**			9.4	9.1	10.5	9.5	9.6
3.3	**Heat output / COP**	**at B-5 / W55** [1]	**kW / ---**	4.0 / 2.0	5.4 / 2.1	7.6 / 2.1	9.4 / 2.0	12.3 / 2.1
		at B0 / W50 [1]	**kW / ---**	4.8 / 2.7	6.2 / 2.7	8.8 / 2.7	10.5 / 2.6	14.2 / 2.8
		at B0 / W35 [1]	**kW / ---**	4.9 / 3.9	6.4 / 3.8	9.2 / 4.0	11.0 / 4.0	14.5 / 4.0
3.4	**Sound power level**		**dB(A)**	54	55	56	56	56
3.5	**Heating water flow with an internal pressure differential of m³/h / Pa**			0.45 / 1900	0.6 /3300	0.75 /2300	1.0 /4100	1.3 / 4800
3.6	**Brine flow with an internal pressure differential (heat source) of m³/h / Pa**			1.2 /16000	1.7 / 29500	2.3 /25000	3.0 /24000	3.5 / 20000
3.7	**Refrigerant; total filling weight**		**type / kg**	R407C / 0.9	R407C / 0.9	R407C / 1.25	R407C / 1.25	R407C / 1.5
4	**Dimensions, connections and weight**							
4.1	**Device dimensions without connections** [2]		**H x W x L mm**	805 × 650 × 462	805 × 650 × 462	805 × 650 × 462	805 × 650 × 462	805 × 650 × 462
4.2	**Device connections to heating system**		**Inch**	G 1¼" external	G 1¼" external	G 1¼" external	G 1¼" external	G 1¼" external
4.3	**Device connections to heat source**		**Inch**	G 1¼" external	G 1¼" external	G 1¼" external	G 1¼" external	G 1¼" external
4.4	**Weight of the transportable unit(s) incl. packing**		**kg**	109	111	118	122	130
5	**Electrical connection**							
5.1	**Nominal voltage; fuse protection**		**V / A**	230 / 16	230 / 16	230 / 20	230 / 25	230 / 32
5.2	**Nominal power consumption** [1]	**B0 W35**	**kW**	1.25	1.68	2.32	2.75	3.62
5.3	**Starting current with soft starter**		**A**	24	26	38	38	50
5.4	**Nominal current B0 W35 / cos φ**		**A / ---**	6.8 / 0.8	9.1 / 0.8	12.6 / 0.8	15.0 / 0.8	19.7 / 0.8
6	**Complies with the European safety regulations**			3	3	3	3	3
7	**Additional model features**							
7.1	**Water in device protected against freezing** [4]			Yes	Yes	Yes	Yes	Yes
7.2	**Performance levels**			1	1	1	1	1
7.3	**Controller internal/external**			Internal	Internal	Internal	Internal	Internal

1. This data indicates the size and capacity of the system according to EN 255 or EN 14511. For an analysis of the economic and energy efficiency of the system, other parameters should also be taken into consideration, in particular the bivalence point and regulation. The specified values, e.g. B10 / W55, have the following meaning: Heat source temperature 10 °C and heating water flow temperature 55 °C.
2. Note that additional space is required for pipe connections, operation and maintenance.
3. See CE declaration of conformity
4. The heat circulating pump and the heat pump controller must always be ready for operation.

3.6 Device Information for Brine-to-Water Heat Pumps (3-Phase, 400V AC)

3.6.1 Low-temperature heat pumps in a compact design SIK 7TE to SIK 14TE

Device information for brine-to-water heat pumps for heating purposes													
1	**Type and order code**			SIK 7TE		SIK 9TE		SIK 11TE		SIK 14TE	
2	**Design**												
2.1	**Design**			Compact		Compact		Compact		Compact	
2.2	**Degree of protection according to EN 60 529**			IP20		IP20		IP20		IP20	
2.3	**Installation location**			Indoors		Indoors		Indoors		Indoors	
3	**Performance data**												
3.1	**Operating temperature limits:**												
	Heating water flow		**°C**	Up to 58		Up to 58		Up to 58		Up to 58	
	Brine (heat source)		**°C**	-5 to +25		-5 to +25		-5 to +25		-5 to +25	
	Antifreeze			Monoethylene glycol		Monoethylene glycol		Monoethylene glycol		Monoethylene glycol	
	Minimum brine concentration (-13 °C freezing temperature)			25%		25%		25%		25%	
3.2	**Temperature spread of heating water (flow/return flow) at B0 / W35K**			9.9	5.0	10.5	5.0	10.1	5.0	9.6	5.0
	Heat output / COP	**at B-5 / W55** [1]	**kW / ---**	5.6 / 2.2		7.7 / 2.3		9.4 / 2.4		12.5 / 2.6	
		at B0 / W45 [1]	**kW / ---**		6.6 / 3.0		8.7 / 3.2		11.2 / 3.2		14.1 / 3.5
		at B0 / W50 [1]	**kW / ---**	6.7 / 2.9		9.0 / 3.1		11.3 / 3.0		14.2 / 3.4	
		at B0 / W35 [1]	**kW / ---**	6.9 / 4.3	6.8 / 4.1	9.2 / 4.4	9.0 / 4.2	11.8 / 4.4	11.7 / 4.2	14.5 / 4.5	14.4 / 4.3
3.3	**Sound power level**		**dB(A)**	51		51		51		51	
3.4	**Heating water flow with an internal pressure differential of m³/h / Pa**			0.6 / 2500	1.2 / 11600	0.75 / 4500	1.6 / 20500	1.0 / 3500	2.0 / 14800	1.3 / 3500	2.5 / 16500
3.5	**Free compression of heat circulating pump (level 3)**		**Pa**	47500	30400	43500	18500	65500	48200	64500	42500
3.6	**Brine flow with an internal pressure differential (heat source) of m³/h / Pa**			1.7 / 10000	1.6 / 9300	2.3 / 16000	2.2 / 15000	3.0 / 13000	2.7 / 11400	3.5 / 13000	3.3 / 11600
3.7	**Free compression of brine circulating pump (level 3)**		**Pa**	55000	56200	44000	46000	40000	44600	34000	38400
3.8	**Refrigerant; total filling weight**		**type / kg**	R407C / 1.5		R407C / 1.8		R407C / 2.0		R407C / 2.3	
4	**Dimensions, connections and weight**												
4.1	**Device dimensions without connections** [2]		**H x W x L mm**	1115 × 652 × 688		1115 × 652 × 688		1115 × 652 × 688		1115 × 652 × 688	
4.2	**Device connections to heating system**		**Inch**	R 1¼" external		R 1¼" external		R 1¼" external		R 1¼" external	
4.3	**Device connections to heat source**		**Inch**	R 1¼" external		R 1¼" external		R 1¼" external		R 1¼" external	
4.4	**Weight of the transportable unit(s) incl. packing**		**kg**	179		180		191		203	
5	**Electrical connection**												
5.1	**Nominal voltage; fuse protection**		**V / A**	400 / 16		400 / 16		400 / 16		400 / 16	
5.2	**Nominal power consumption** [1]	**B0 W35**	**kW**	1.6	1.66	2.07	2.14	2.66	2.79	3.22	3.37
5.3	**Starting current with soft starter**		**A**	30 (without SS)		15		26		26	
5.4	**Nominal current B0 W35 / cos φ**		**A / ---**	2.89 / 0.8	3 / 0.8	3.77 / 0.8	3.86 / 0.8	4.84 / 0.8	5.03 / 0.8	5.81 / 0.8	6.08 / 0.8
6	**Complies with the European safety regulations**			[3]		[3]		[3]		[3]	
7	**Additional model features**												
7.1	**Water in device protected against freezing** [4]			Yes		Yes		Yes		Yes	
7.2	**Performance levels**			1		1		1		1	
7.3	**Controller internal/external**			Internal		Internal		Internal		Internal	

1. This data indicates the size and capacity of the system according to EN 255 or EN 14511. For an analysis of the economic and energy efficiency of the system, the bivalence point and regulation should be taken into consideration. The specified values, e.g. B10 / W55, have the following meaning: Heat source temperature 10 °C and heating water flow temperature 55 °C.
2. Note that additional space is required for pipe connections, operation and maintenance.
3. See CE declaration of conformity
4. The heat circulating pump and the heat pump controller must always be ready for operation.

3.6.2 Low-temperature heat pumps SI 5TE to SI 11TE

Device information for brine-to-water heat pumps for heating purposes												
1	**Type and order code**			SI 5TE		SI 7TE		SI 9TE		SI 11TE	
2	**Design**										
2.1	**Degree of protection according to EN 60 529**			IP20		IP20		IP20		IP20	
2.2	**Installation location**			Indoors		Indoors		Indoors		Indoors	
3	**Performance data**										
3.1	**Operating temperature limits:**										
	Heating water flow		°C	Up to 58		Up to 58		Up to 58		Up to 58	
	Brine (heat source)		°C	-5 to +25		-5 to +25		-5 to +25		-5 to +25	
	Antifreeze			Monoethylene glycol		Monoethylene glycol		Monoethylene glycol		Monoethylene glycol	
	Minimum brine concentration (-13 °C freezing temperature)			25%		25%		25%		25%	
3.2	**Temperature spread of heating water (flow/return flow) at B0 / W35K**			10.1	5.0	9.9	5.0	10.5	5.0	10.1	5.0
3.3	**Heat output / COP**	**at B-5 / W55** [1]	**kW / ---**	3.8 / 2.0		5.6 / 2.2		7.7 / 2.3		9.4 / 2.4	
		at B0 / W45 [1]	**kW / ---**		5.0 / 2.9		6.6 / 3.0		8.7 / 3.2		11.2 / 3.2
		at B0 / W50 [1]	**kW / ---**	4.8 / 2.8		6.7 / 2.9		9.0 / 3.1		11.3 / 3.0	
		at B0 / W35 [1]	**kW / ---**	5.3 / 4.3	5.2 / 4.1	6.9 / 4.3	6.8 / 4.1	9.2 / 4.4	9.0 / 4.2	11.8 / 4.4	11.7 / 4.2
3.4	**Sound power level**		**dB(A)**	54		55		56		56	
3.5	**Heating water flow with an internal pressure differential of m³/h / Pa**			0.45 / 1900	0.9 / 7400	0.6 / 3300	1.2 / 13000	0.75 / 2300	1.6 / 10300	1.0 / 4100	2.0 / 16100
3.6	**Brine flow with an internal pressure differential (heat source) of m³/h / Pa**			1.2 / 16000	1.2 / 16000	1.7 / 29500	1.6 / 26500	2.3 / 25000	2.2 / 23000	3.0 / 24000	2.7 / 20000
3.7	**Refrigerant; total filling weight**		**type / kg**	R407C / 1.2		R407C / 1.1		R407C / 1.6		R407C / 1.7	
4	**Dimensions, connections and weight**										
4.1	**Device dimensions without connections** [2]		**H x W x L mm**	805 × 650 × 462		805 × 650 × 462		805 × 650 × 462		805 × 650 × 462	
4.2	**Device connections to heating system**		**Inch**	G 1¼" external		G 1¼" external		G 1¼" external		G 1¼" external	
4.3	**Device connections to heat source**		**Inch**	G 1¼" external		G 1¼" external		G 1¼" external		G 1¼" external	
4.4	**Weight of the transportable unit(s) incl. packing**		**kg**	109		111		118		122	
5	**Electrical connection**										
5.1	**Nominal voltage; fuse protection**		**V / A**	400 / 16		400 / 16		400 / 16		400 / 16	
5.2	**Nominal power consumption** [1]	**B0 W35**	**kW**	1.23	1.27	1.6	1.66	2.07	2.14	2.66	2.79
5.3	**Starting current with soft starter**		**A**	22 (without SS)		30 (without SS)		15		26	
5.4	**Nominal current B0 W35 / cos φ**		**A / ---**	2.22 / 0.8	2.29 / 0.8	2.89 / 0.8	3 / 0.8	3.77 / 0.8	3.86 / 0.8	4.84 / 0.8	5.03 / 0.8
6	**Complies with the European safety regulations**			3		3		3		3	
7	**Additional model features**										
7.1	**Water in device protected against freezing** [4]			Yes		Yes		Yes		Yes	
7.2	**Performance levels**			1		1		1		1	
7.3	**Controller internal/external**			Internal		Internal		Internal		Internal	

1. This data indicates the size and capacity of the system according to EN 255 or EN 14511. For an analysis of the economic and energy efficiency of the system, the bivalence point and regulation should be taken into consideration. The specified values, e.g. B10 / W55, have the following meaning: Heat source temperature 10 °C and heating water flow temperature 55 °C.
2. Note that additional space is required for pipe connections, operation and maintenance.
3. See CE declaration of conformity
4. The heat circulating pump and the heat pump controller must always be ready for operation.

3.6.3 Low-temperature heat pumps SI 14TE to SI 21TE

Device information for brine-to-water heat pumps for heating purposes									
1	**Type and order code**			SI 14TE		SI 17TE		SI 21TE	
2	**Design**								
2.1	**Degree of protection according to EN 60 529**			IP20		IP20		IP20	
2.2	**Installation location**			Indoors		Indoors		Indoors	
3	**Performance data**								
3.1	**Operating temperature limits:**								
	Heating water flow		**°C**	Up to 58		Up to 58		Up to 58	
	Brine (heat source)		**°C**	-5 to +25		-5 to +25		-5 to +25	
	Antifreeze			Monoethylene glycol		Monoethylene glycol		Monoethylene glycol	
	Minimum brine concentration (-13 °C freezing temperature)			25%		25%		25%	
3.2	**Temperature spread of heating water (flow/return flow) at B0 / W35K**			9.6	5.0	9.3	5.0	11.3	5.0
3.3	**Heat output / COP**	**at B-5 / W55** [1]	**kW / ---**	12.5 / 2.6		14.4 / 2.6		17.9 / 2.5	
		at B0 / W45 [1]	**kW / ---**		14.1 / 3.5		16.2 / 3.4		19.8 / 3.2
		at B0 / W50 [1]	**kW / ---**	14.2 / 3.4		16.7 / 3.2		20.4 / 3.1	
		at B0 / W35 [1]	**kW / ---**	14.5 / 4.5	14.4 / 4.3	17.1 / 4.6	16.9 / 4.4	21.1 / 4.3	20.8 / 4.1
3.4	**Sound power level**		**dB(A)**	56		58		59	
3.5	**Heating water flow with an internal pressure differential of m³/h / Pa**			1.3 / 4800	2.5 / 17600	1.5 / 4000	2.9 / 15000	1.6 / 4600	3.6 / 23000
3.6	**Brine flow with an internal pressure differential (heat source) of m³/h / Pa**			3.5 / 20000	3.3 / 18000	3.8 / 18000	3.8 / 18000	5.5 / 10000	5.4 / 9800
3.7	**Refrigerant; total filling weight**		**type / kg**	R407C / 2.1		R407C / 2.3		R407C / 4.5	
4	**Dimensions, connections and weight**								
4.1	**Device dimensions without connections** [2]		**H x W x L mm**	805 × 650 × 462		805 × 650 × 462		1445 × 650 × 575	
4.2	**Device connections to heating system**		**Inch**	G 1¼" external		G 1¼" external		G 1¼" external	
4.3	**Device connections to heat source**		**Inch**	G 1¼" external		G 1¼" external		G 1½" external	
4.4	**Weight of the transportable unit(s) incl. packing**		**kg**	130		133		225	
5	**Electrical connection**								
5.1	**Nominal voltage; fuse protection**		**V / A**	400 / 16		400 / 16		400 / 20	
5.2	**Nominal power consumption** [1]	**B0 W35**	**kW**	3.22	3.37	3.72	3.86	4.91	5.10
5.3	**Starting current with soft starter**		**A**	26		27		29	
5.4	**Nominal current B0 W35 / cos φ**		**A / ---**	5.81 / 0.8	6.08 / 0.8	6.35 / 0.8	6.64 / 0.8	8.86 / 0.8	9.2 / 0.8
6	**Complies with the European safety regulations**			[3]		[3]		[3]	
7	**Additional model features**								
7.1	**Water in device protected against freezing** [4]			Yes		Yes		Yes	
7.2	**Performance levels**			1		1		1	
7.3	**Controller internal/external**			Internal		Internal		Internal	

1. This data indicates the size and capacity of the system according to EN 255 or EN 14511. For an analysis of the economic and energy efficiency of the system. the bivalence point and regulation should be taken into consideration. The specified values, e.g. B10 / W55, have the following meaning: Heat source temperature 10 °C and heating water flow temperature 55 °C.
2. Note that additional space is required for pipe connections, operation and maintenance.
3. See CE declaration of conformity
4. The heat circulating pump and the heat pump controller must always be ready for operation.

3.6.4 Low-temperature heat pumps SI 24TE to SI 37TE

Device information for brine-to-water heat pumps for heating purposes								
1	**Type and order code**				SI 24TE		SI 37TE	
2	**Design**							
2.1	**Degree of protection according to EN 60 529**				IP21		IP21	
2.2	**Installation location**				Indoors		Indoors	
3	**Performance data**							
3.1	**Operating temperature limits:**							
	Heating water flow		°C		Up to 60		Up to 60	
	Brine (heat source)		°C		-5 to +25		-5 to +25	
	Antifreeze				Monoethylene glycol		Monoethylene glycol	
	Minimum brine concentration (-13 °C freezing temperature)				25%		25%	
3.2	**Temperature spread of heating water (flow/return flow) at B0 / W35K**				9.4	5.0	9.8	5.0
3.3	**Heat output / COP**	**at B-5 / W55** [1]	**kW / ---**	[2]	19.7 / 2.3		28.9 / 2.4	
			kW / ---	[3]	9.3 / 2.1		12.1 / 2.2	
		at B0 / W45 [1]	**kW / ---**	[2]		22.3 / 3.1		33.0 / 3.3
			kW / ---	[3]		11.3 / 3.1		13.4 / 2.8
		at B0 / W50 [1]	**kW / ---**	[2]	22.7 / 2.9		34.3 / 3.1	
			kW / ---	[3]	10.8 / 2.7		13.1 / 2.4	
		at B0 / W35 [1]	**kW / ---**	[2]	24.0 / 4.3	23.7 / 4.1	37.2 / 4.6	35.4 / 4.3
			kW / ---	[3]	12.5 / 4.4	12.7 / 4.3	17.0 / 4.2	18.3 / 4.5
3.4	**Sound power level**		**dB(A)**					
3.5	**Sound pressure level at a distance of 1 m**		**dB(A)**					
3.6	**Heating water flow with an internal pressure differential of m³/h / Pa**				2.2 / 3100	4.0 / 9800	3.2 / 1650	6.0 / 5100
3.7	**Brine flow with an internal pressure differential (heat source) of m³/h / Pa**				5.6 / 13000	5.6 / 13000	8.5 / 10000	8.5 / 10000
3.8	**Refrigerant; total filling weight**		**type / kg**		R404A / 3.7		R404A / 6.8	
4	**Dimensions, connections and weight**							
4.1	**Device dimensions without connections** [4]		**H x W x L mm**		1660 x 1000 x 775		1660 x 1000 x 775	
4.2	**Device connections to heating system**		**Inch**		G 1 1/4" internal/external		G 1 1/4" internal/external	
4.3	**Device connections to heat source**		**Inch**		G 1 1/2" internal/external		G 2" internal/external	
4.4	**Weight of the transportable unit(s) incl. packing**		**kg**		282		371	
5	**Electrical connection**							
5.1	**Nominal voltage; fuse protection**		**V / A**		400 / 20		400 / 20	
5.2	**Nominal power consumption** [1] **B0 W35**		**kW**		5.61	5.81	7.96	8.17
5.3	**Starting current with soft starter**		**A**		20		26	
5.4	**Nominal current B0 W35 / cos φ** [2]		**A / ---**		10.12 / 0.8	10.48 / 0.8	14.40 / 0.8	14.92 / 0.8
6	**Complies with the European safety regulations**				[5]		[5]	
7	**Additional model features**							
7.1	**Water in device protected against freezing** [6]				Yes		Yes	
7.2	**Performance levels**				2		2	
7.3	**Controller internal/external**				Internal		Internal	

1. This data indicates the size and capacity of the system according to EN 255 or EN 14511. For an analysis of the economic and energy efficiency of the system, the bivalence point and regulation should be taken into consideration. The specified values, e.g. B10 / W55, have the following meaning: Heat source temperature 10 °C and heating water flow temperature 55 °C.
2. Operation with 2 compressors
3. Operation with 1 compressors
4. Note that additional space is required for pipe connections, operation and maintenance.
5. See CE declaration of conformity
6. The heat circulating pump and the heat pump controller must always be ready for operation.

3.6.5 Low-temperature heat pumps SI 50TE to SI 130TE

Device information for brine-to-water heat pumps for heating purposes								
1	**Type and order code**				SI 50TE	SI 75TE	SI 100TE	SI 130TE
2	**Design**							
2.1	**Degree of protection according to EN 60 529**				IP21	IP21	IP21	IP21
2.2	**Installation location**				Indoors	Indoors	Indoors	Indoors
3	**Performance data**							
3.1	**Operating temperature limits:**							
	Heating water flow		**°C**		Up to 60	Up to 60	Up to 60	Up to 60
	Brine (heat source)		**°C**		-5 to +25	-5 to +25	-5 to +25	-5 to +25
	Antifreeze				Monoethylene glycol	Monoethylene glycol	Monoethylene glycol	Monoethylene glycol
	Minimum brine concentration (-13 °C freezing temperature)				25%	25%	25%	25%
3.2	**Temperature spread of heating water (flow/return flow) at B0 / W35K**				8.9	9.9	9.7	9.4
3.3	**Heat output / COP**	**at B-5 / W55 [1]**	**kW / ---**	**[2]**	37.5 / 2.4	59.8 / 2.3	76.2 / 2.5	102.1 / 2.3
			kW / ---	**[3]**	15.0 / 2.1	30.1 / 2.2	33.6 / 2.4	40.3 / 2.0
		at B0 / W50 [1]	**kW / ---**	**[2]**	43.8 / 3.0	69.8 / 2.9	87.9 / 3.1	117.0 / 2.9
			kW / ---	**[3]**	18.5 / 2.5	33.3 / 2.8	39.1 / 2.8	51.0 / 2.4
		at B0 / W35 [1]	**kW / ---**	**[2]**	46.7 / 4.5	75.2 / 4.4	96.3 / 4.6	125.8 / 4.3
			kW / ---	**[3]**	23.0 / 4.4	37.6 / 4.3	48.4 / 4.6	63.3 / 4.2
3.4	**Sound power level**		**dB(A)**		65	69	71	73
3.5	**Sound pressure level at a distance of 1 m**		**dB(A)**		50	54	55	56
3.6	**Heating water flow with an internal pressure differential of m³/h / Pa**				4.5 / 2000	6.5 / 2500	8.5 / 3600	11.5 / 2200
3.7	**Brine flow with an internal pressure differential (heat source) of m³/h / Pa**				12.8 / 15700	20.5 / 17800	24.0 / 18600	34.0 / 26200
3.8	**Refrigerant; total filling weight**		**type / kg**		R404A / 8.6	R404A / 14.1	R404A / 20.5	R404A / 27.0
4	**Dimensions, connections and weight**							
4.1	**Device dimensions without connections [4]**		**H x W x L mm**		1890 x 1350 x 775	1890 x 1350 x 775	1890 x 1350 x 775	1890 x 1350 x 775
4.2	**Device connections to heating system**		**Inch**		G 1 1/2" internal/ external	G 2" internal/ external	G 2" internal/ external	G 2 1/2" internal/ external
4.3	**Device connections to heat source**		**Inch**		G 2 1/2" internal/ external	G 2 1/2" internal/ external	G 3" internal/ external	G 3" internal/ external
4.4	**Weight of the transportable unit(s) incl. packing**		**kg**		486	571	652	860
5	**Electrical connection**							
5.1	**Nominal voltage; fuse protection**		**V / A**		400 / 50	400 / 63	400 / 80	400 / 80
5.2	**Nominal power consumption [1] B0 W35**		**kW**		10.45	16.95	20.93	29.24
5.3	**Starting current with soft starter**		**A**		56	105	120	115
5.4	**Nominal current B0 W35 / cos φ**		**A / ---**		18.9 / 0.8	30.58 / 0.8	37.8 / 0.8	52.76 / 0.8
6	**Complies with the European safety regulations**				[5]	[5]	[5]	[5]
7	**Additional model features**							
7.1	**Water in device protected against freezing [6]**				Yes	Yes	Yes	Yes
7.2	**Performance levels**				2	2	2	2
7.3	**Controller internal/external**				Internal	Internal	Internal	Internal

1. This data indicates the size and capacity of the system according to EN 255 or EN 14511. For an analysis of the economic and energy efficiency of the system, the bivalence point and regulation should be taken into consideration. The specified values, e.g. B10 / W55, have the following meaning: Heat source temperature 10 °C and heating water flow temperature 55 °C.
2. Operation with 2 compressors
3. Operation with 1 compressors
4. Note that additional space is required for pipe connections, operation and maintenance.
5. See CE declaration of conformity
6. The heat circulating pump and the heat pump controller must always be ready for operation.

3.6.6 High-temperature heat pumps SIH 20TE

Device information for brine-to-water heat pumps for heating purposes						
1	**Type and order code**				SIH 20TE	
2	**Design**					
2.1	**Degree of protection according to EN 60 529**				IP21	
2.2	**Installation location**				Indoors	
3	**Performance data**					
3.1	**Operating temperature limits:**					
	Heating water flow		**°C**		Up to 70	
	Brine (heat source)		**°C**		-5 to +25	
	Antifreeze				Monoethylene glycol	
	Minimum brine concentration (-13 °C freezing temperature)				25%	
3.2	**Temperature spread of heating water (flow/return flow) at B0 / W35K**				9.9	5.0
3.3	**Heat output / COP**	**at B-5 / W55 [1]**	**kW / ---**	[2]	18.1 / 2.5	
			kW / ---	[3]	9.1 / 2.5	
		at B0 / W45 [1]	**kW / ---**	[2]		20.5 / 3.4
			kW / ---	[3]		10.5 / 3.4
		at B0 / W50 [1]	**kW / ---**	[2]	21.3 / 3.3	
			kW / ---	[3]	10.5 / 3.2	
		at B0 / W35 [1]	**kW / ---**	[2]	21.8 / 4.7	21.4 / 4.4
			kW / ---	[3]	11.8 / 4.8	11.5 / 4.6
3.4	**Sound power level**		**dB(A)**		62	
3.5	**Sound pressure level at a distance of 1 m**		**dB(A)**		47	
3.6	**Heating water flow with an internal pressure differential of m³/h / Pa**				1.9 / 2310	3.7 / 8500
3.7	**Brine flow with an internal pressure differential (heat source) of m³/h / Pa**				5.1 / 11000	4.9 / 10200
3.8	**Refrigerant; total filling weight**		**type / kg**		R134a / 4.2	
4	**Dimensions, connections and weight**					
4.1	**Device dimensions without connections [4]**		**H x W x L mm**		1660 x 1000 x 775	
4.2	**Device connections to heating system**		**Inch**		G 1 1/4" internal/external	
4.3	**Device connections to heat source**		**Inch**		G 1 1/2" internal/external	
4.4	**Weight of the transportable unit(s) incl. packing**		**kg**		307	
5	**Electrical connection**					
5.1	**Nominal voltage; fuse protection**		**V / A**		400 / 25	
5.2	**Nominal power consumption [1] B0 W35**		**kW**		4.70	4.86
5.3	**Starting current with soft starter**		**A**		30	
5.4	**Nominal current B0 W35 / cos φ [2]**		**A / ---**		8.48 / 0.8	8.77 / 0.8
6	**Complies with the European safety regulations**				[5]	
7	**Additional model features**					
7.1	**Water in device protected against freezing [6]**				Yes	
7.2	**Performance levels**				2	
7.3	**Controller internal/external**				Internal	

1. This data indicates the size and capacity of the system according to EN 255 or EN 14511. For an analysis of the economic and energy efficiency of the system, the bivalence point and regulation should be taken into consideration. The specified values, e.g. B10 / W55, have the following meaning: Heat source temperature 10 °C and heating water flow temperature 55 °C.
2. Operation with 2 compressors
3. Operation with 1 compressors
4. Note that additional space is required for pipe connections, operation and maintenance.
5. See CE declaration of conformity
6. The heat circulating pump and the heat pump controller must always be ready for operation.

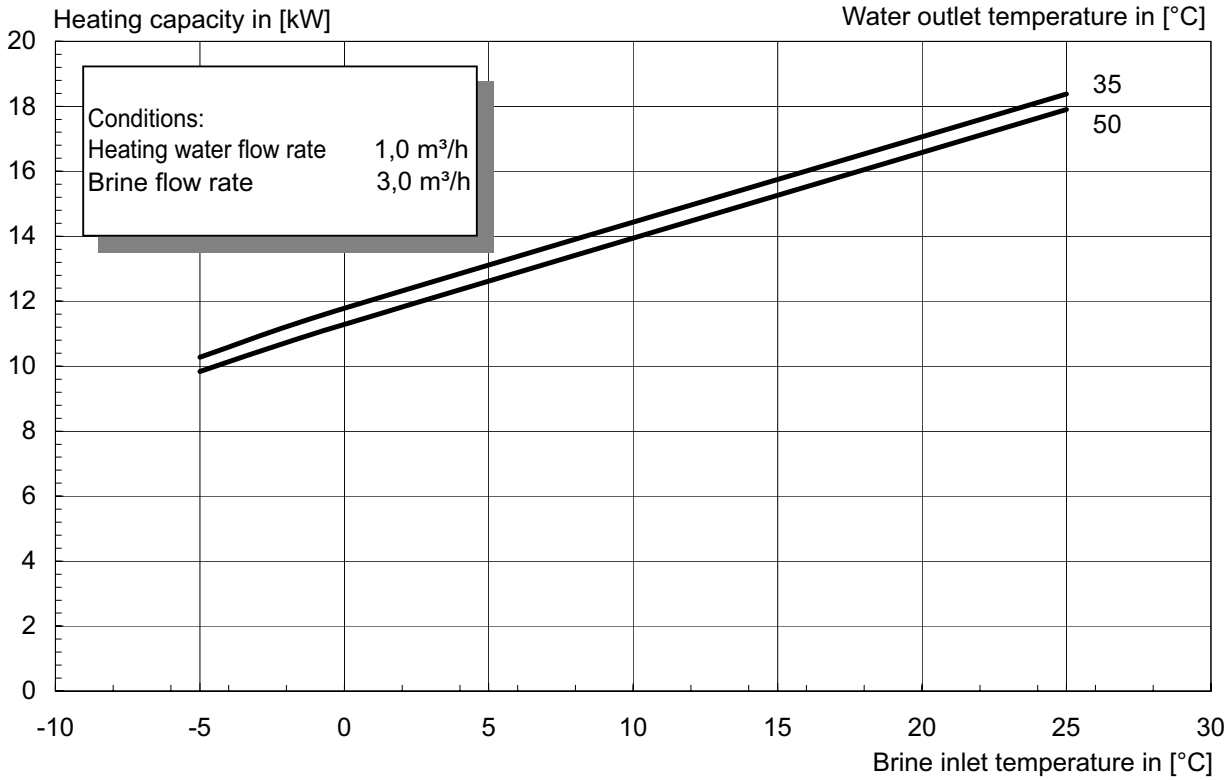
3.6.7 High-temperature heat pumps SIH 40TE

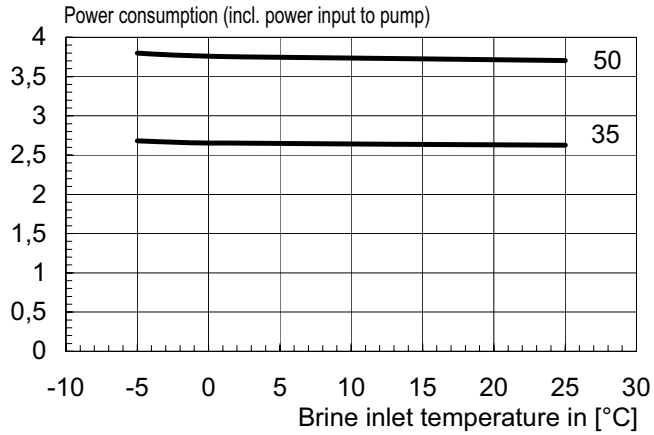
Device information for brine-to-water heat pumps for heating purposes						
1	**Type and order code**				SIH 40TE	
2	**Design**					
2.1	**Degree of protection according to EN 60 529**				IP21	
2.2	**Installation location**				Indoors	
3	**Performance data**					
3.1	**Operating temperature limits:**					
	Heating water flow		**°C**		Up to 70	
	Brine (heat source)		**°C**		-5 to +25	
	Antifreeze				Monoethylene glycol	
	Minimum brine concentration (-13 °C freezing temperature)				25%	
3.2	**Temperature spread of heating water (flow/return flow) at B0 / W35K**				9.8	5.0
3.3	**Heat output / COP**	**at B-5 / W55** [1]	**kW / ---**	[2]	28.9 / 2.4	
			kW / ---	[3]	10.6 / 2.1	
		at B0 / W45 [1]	**kW / ---**	[2]		31.7 / 3.2
			kW / ---	[3]		12.9 / 2.5
		at B0 / W50 [1]	**kW / ---**	[2]	33.1 / 3.1	
			kW / ---	[3]	13.5 / 2.4	
		at B0 / W35 [1]	**kW / ---**	[2]	36.6 / 4.4	34.2 / 4.1
			kW / ---	[3]	18.6 / 4.4	17.4 / 4.1
3.4	**Sound power level**		**dB(A)**		65	
3.5	**Sound pressure level at a distance of 1 m**		**dB(A)**		50	
3.6	**Heating water flow with an internal pressure differential of m³/h / Pa**				3.2 / 1100	5.5 / 2900
3.7	**Brine flow with an internal pressure differential (heat source) of m³/h / Pa**				11.0 / 11900	8.8 / 7800
3.8	**Refrigerant; total filling weight**		**type / kg**		R134a / 8.0	
4	**Dimensions, connections and weight**					
4.1	**Device dimensions without connections** [4]		**H x W x L mm**		1890 x 1350 x 775	
4.2	**Device connections to heating system**		**Inch**		G 1 1/2" internal/external	
4.3	**Device connections to heat source**		**Inch**		G 2 1/2" internal/external	
4.4	**Weight of the transportable unit(s) incl. packing**		**kg**		502	
5	**Electrical connection**					
5.1	**Nominal voltage; fuse protection**		**V / A**		400 / 63	
5.2	**Nominal power consumption** [1] **B0 W35**		**kW**		8.36	8.35
5.3	**Starting current with soft starter**		**A**		84	
5.4	**Nominal current B0 W35 / cos φ** [2]		**A / ---**		15.09 / 0.8	15.06 / 0.8
6	**Complies with the European safety regulations**				[5]	
7	**Additional model features**					
7.1	**Water in device protected against freezing** [6]				Yes	
7.2	**Performance levels**				2	
7.3	**Controller internal/external**				Internal	

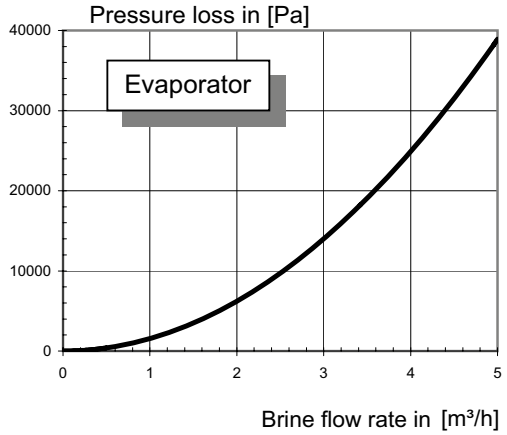
1. This data indicates the size and capacity of the system according to EN 255 or EN 14511. For an analysis of the economic and energy efficiency of the system, the bivalence point and regulation should be taken into consideration. The specified values, e.g. B10 / W55, have the following meaning: Heat source temperature 10 °C and heating water flow temperature 55 °C.
2. Operation with 2 compressors
3. Operation with 1 compressors
4. Note that additional space is required for pipe connections, operation and maintenance.
5. See CE declaration of conformity
6. The heat circulating pump and the heat pump controller must always be ready for operation.

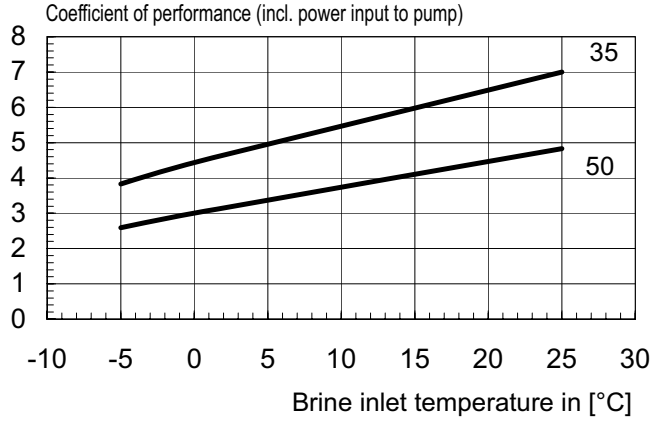
3.7 Characteristic Curves for Brine-to-Water Heat Pumps (1-Phase, 230 V AC)

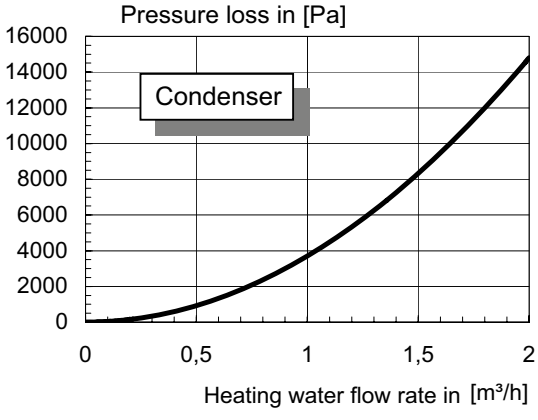
3.7.1 Characteristic curves SIK 11ME



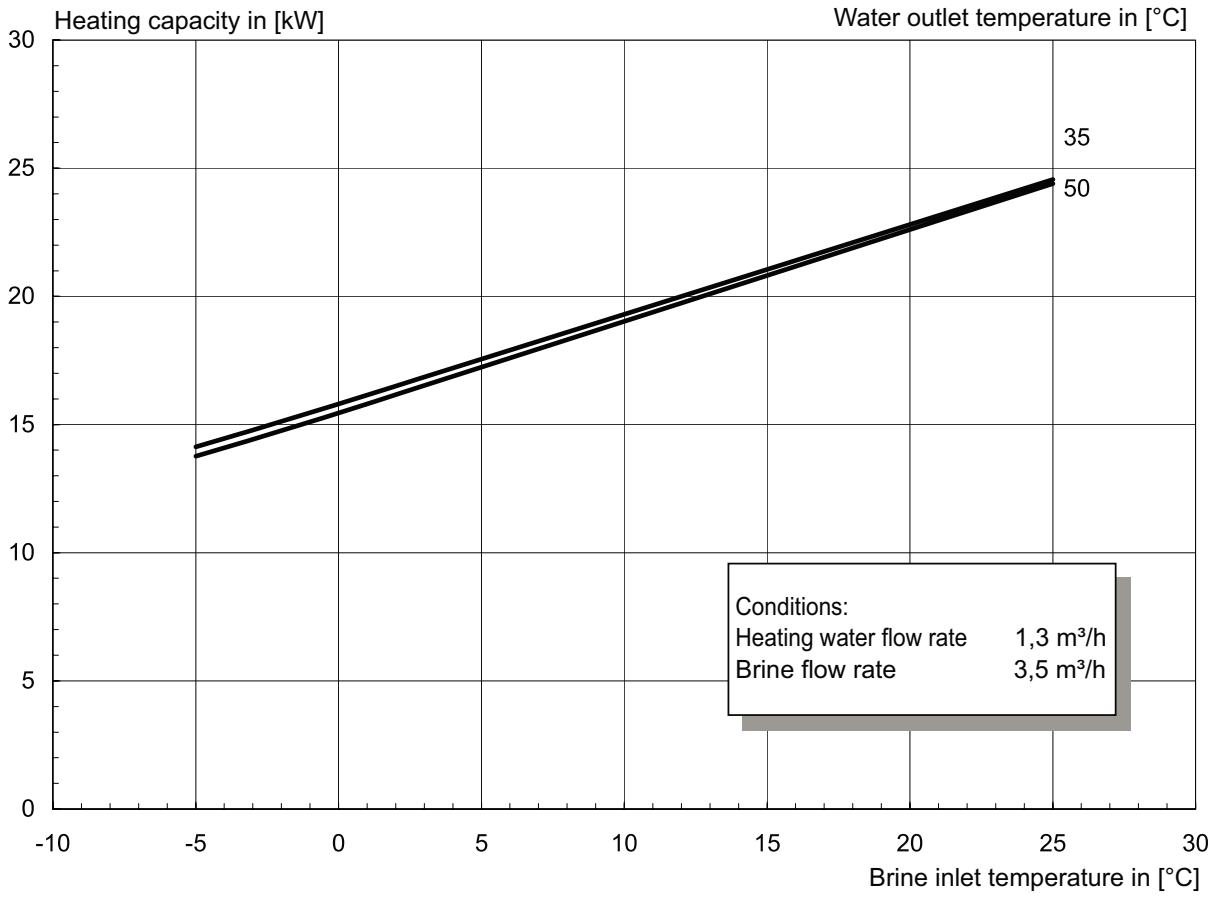


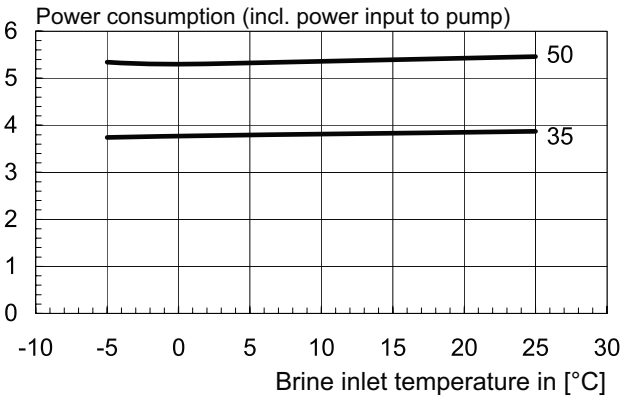


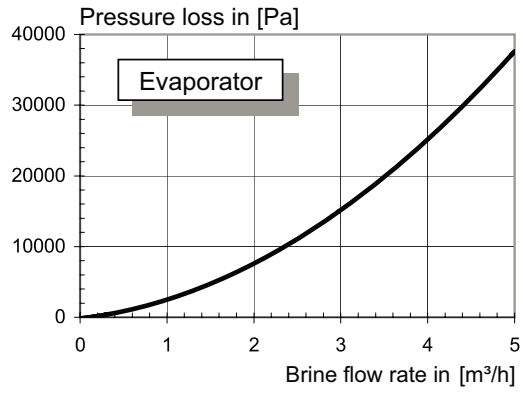


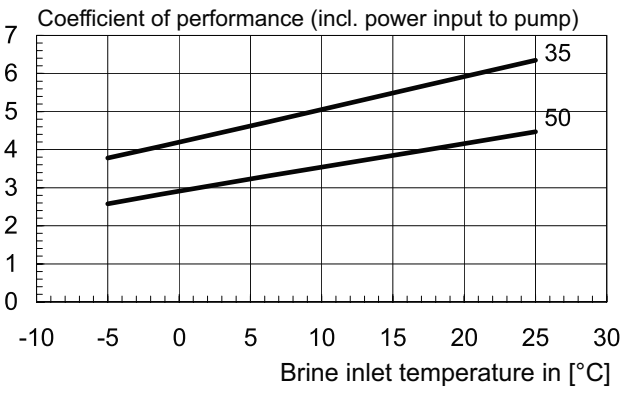


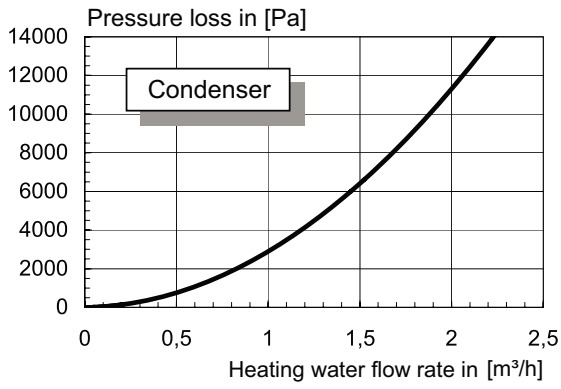
3.7.2 Characteristic curves SIK 16ME



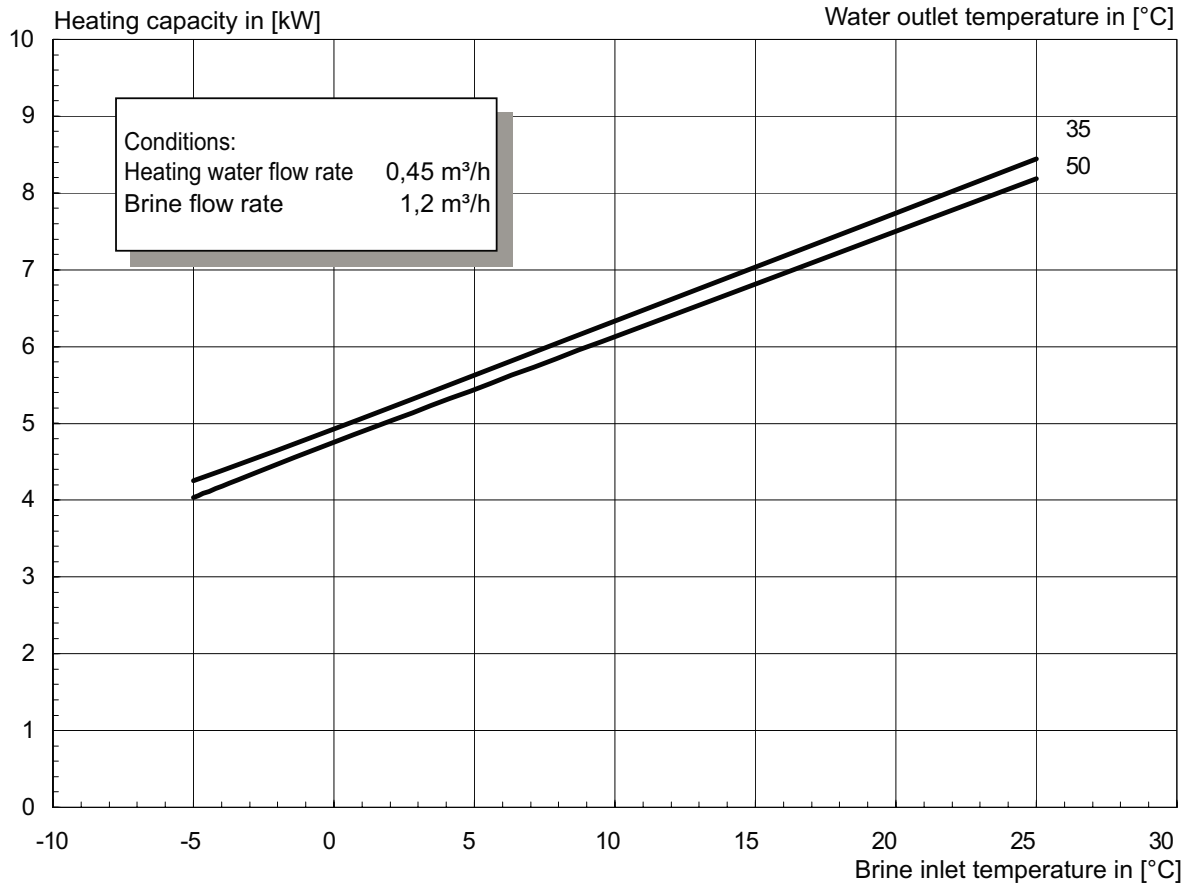


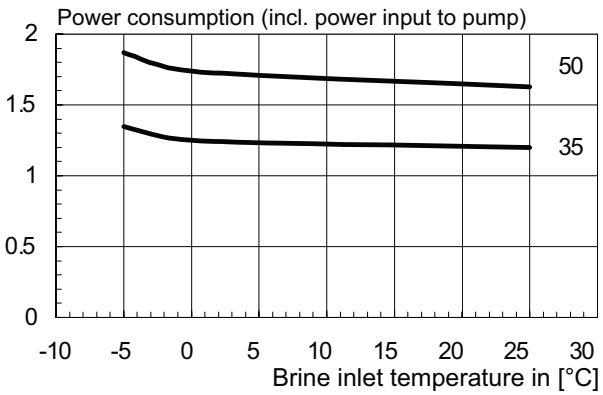


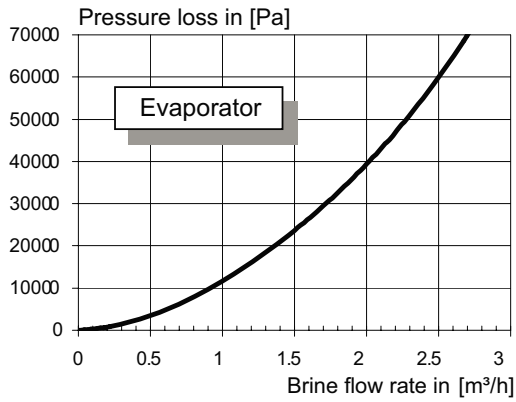


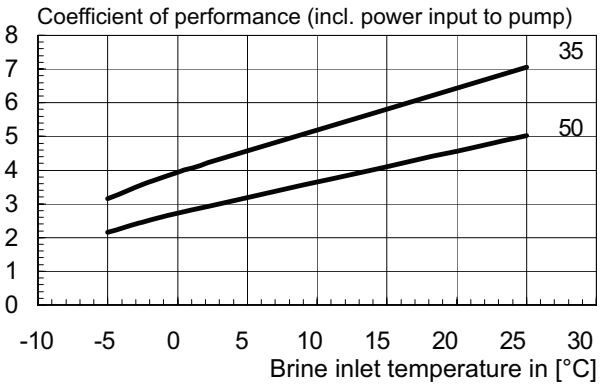


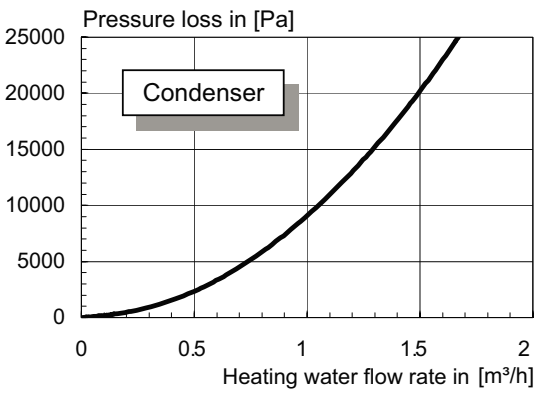
3.7.3 Characteristic curves SI 5ME



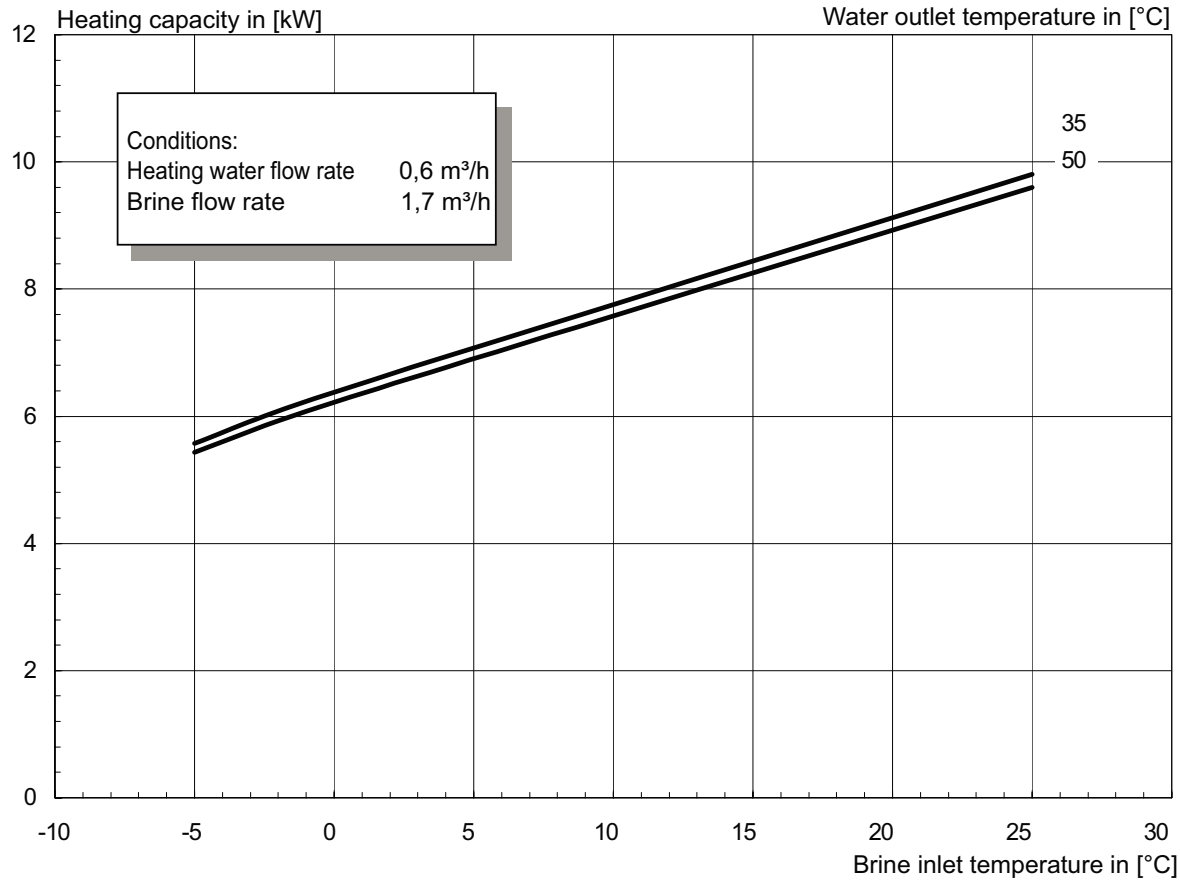


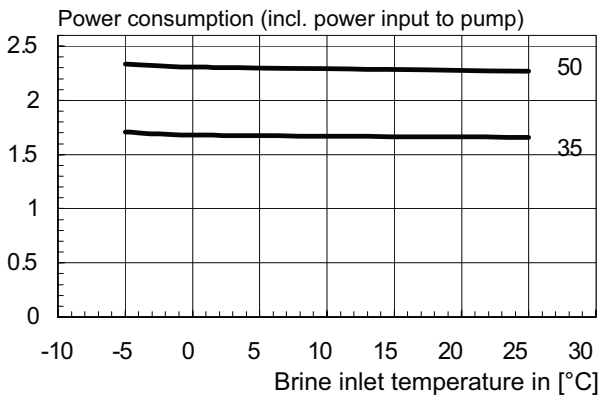


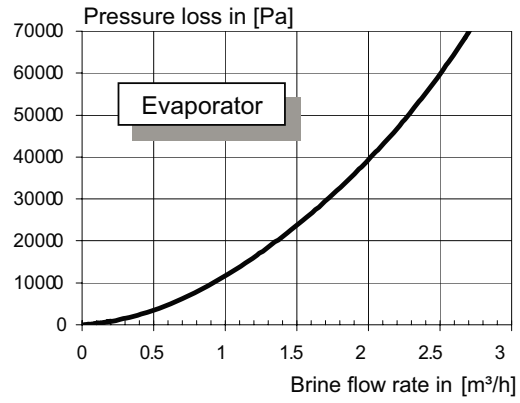


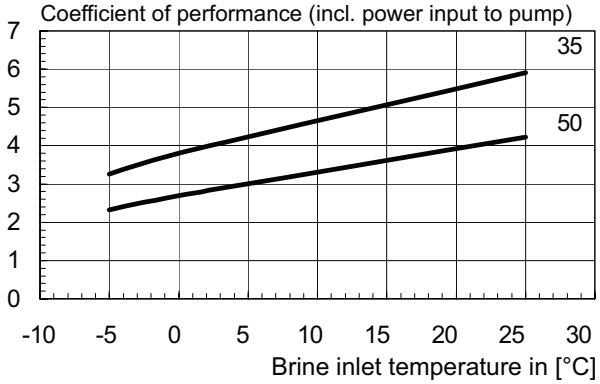


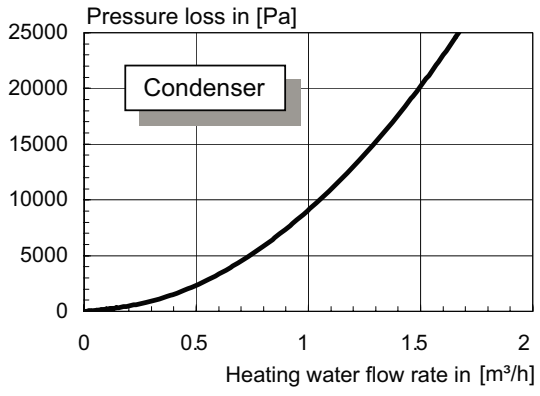
3.7.4 Characteristic curves SI 7ME



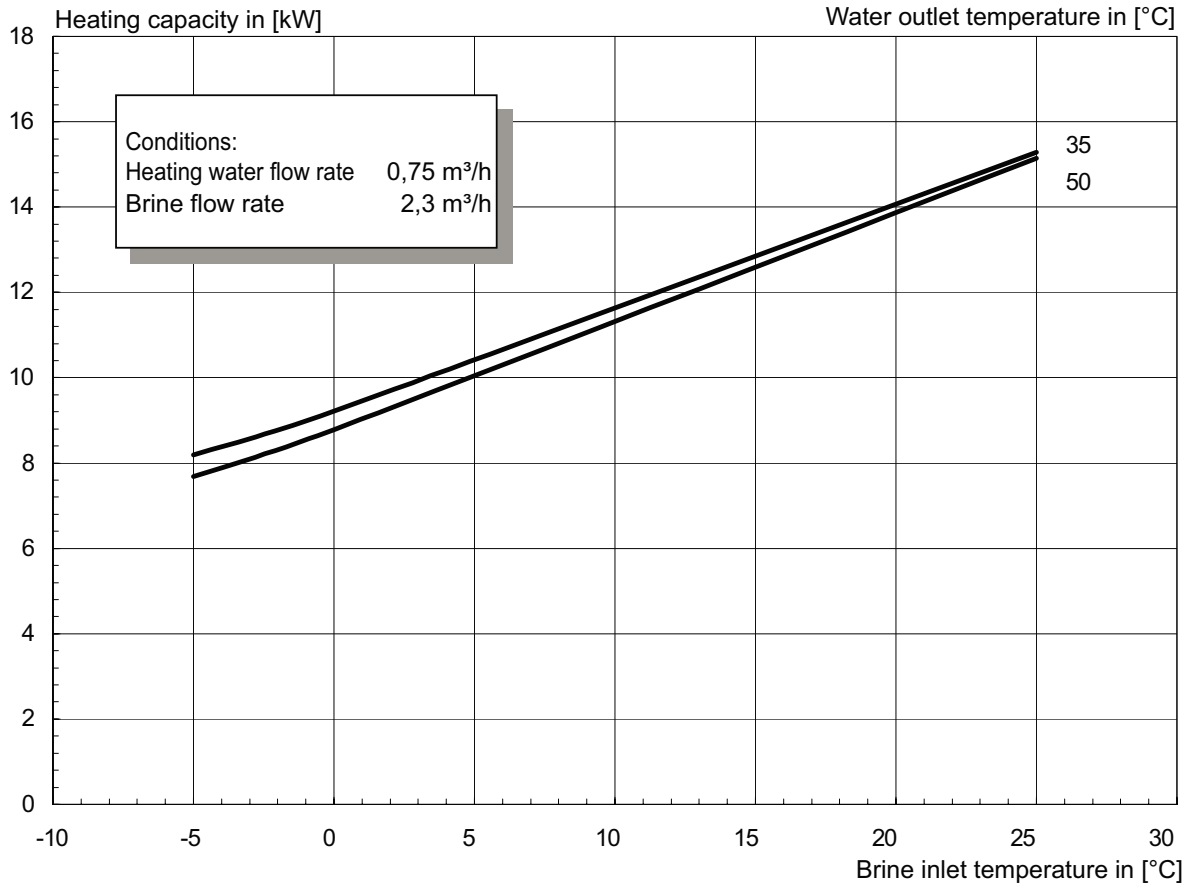


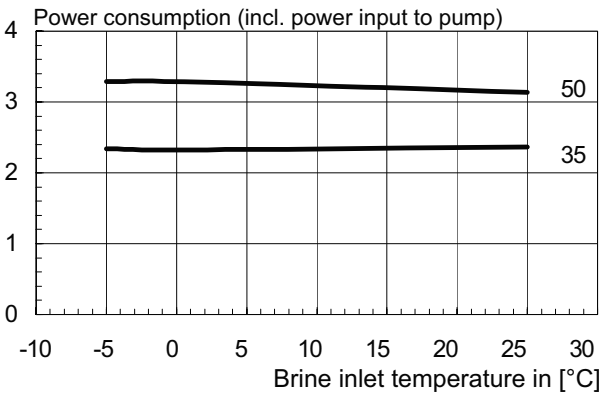


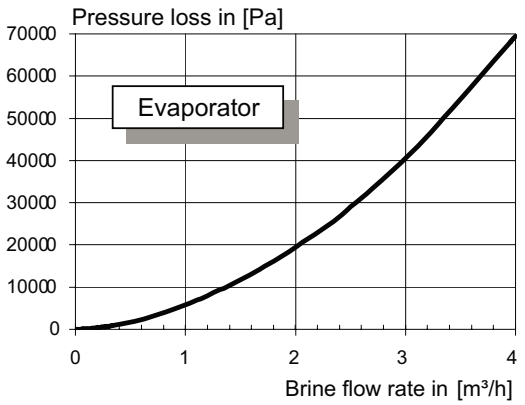


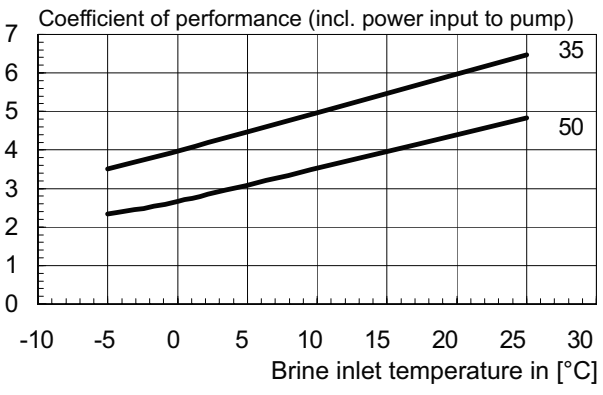


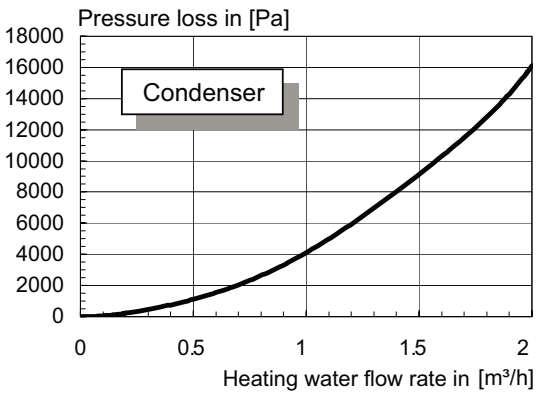
3.7.5 Characteristic curves SI 9ME



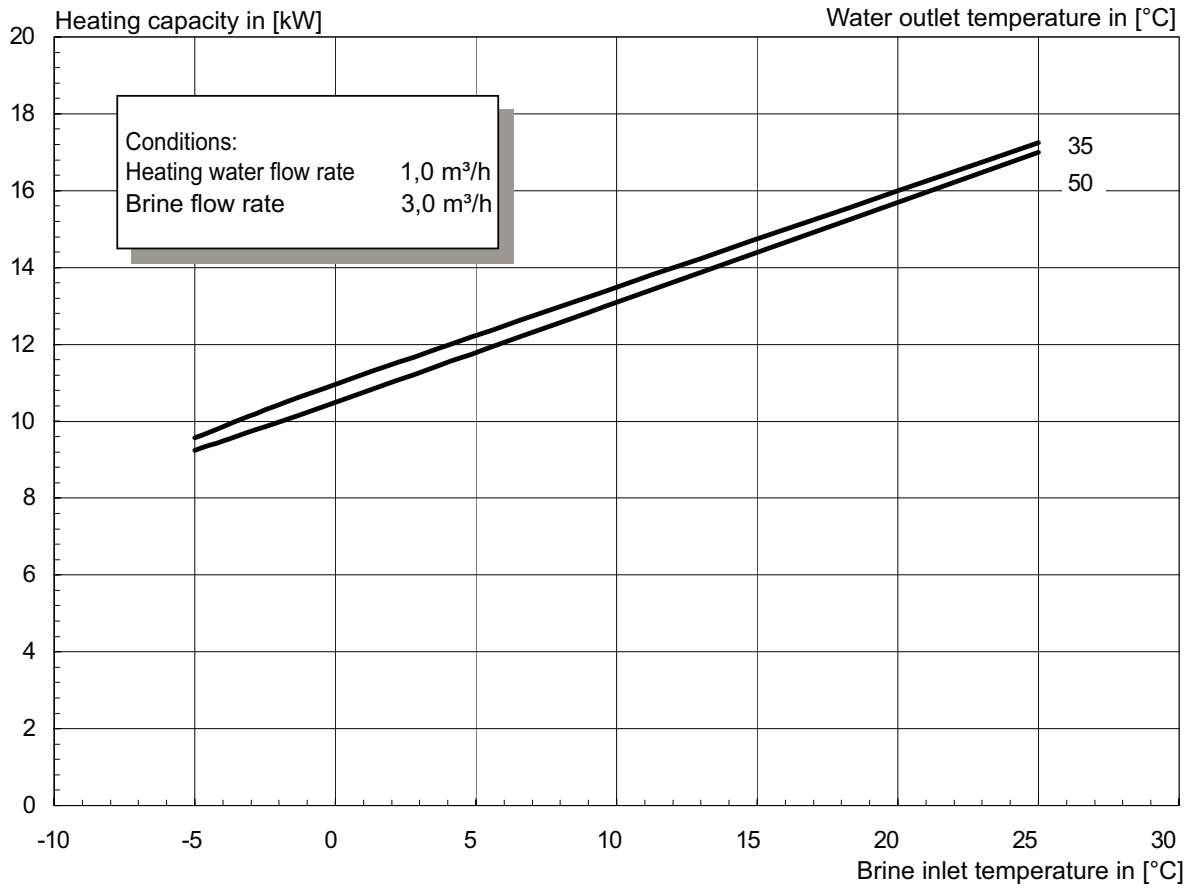


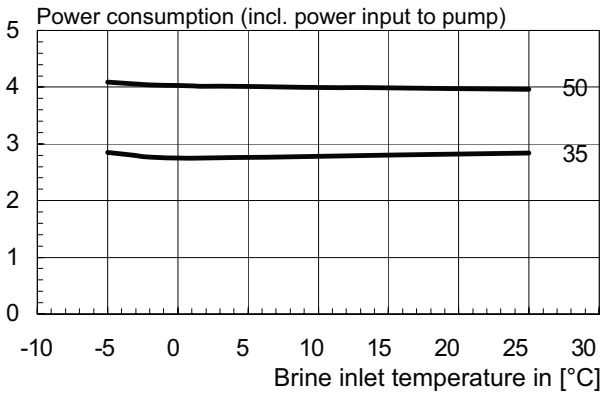


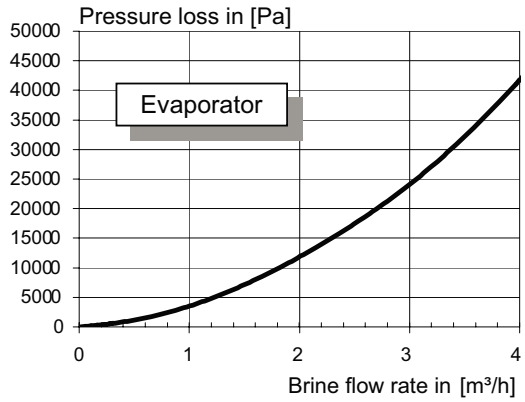


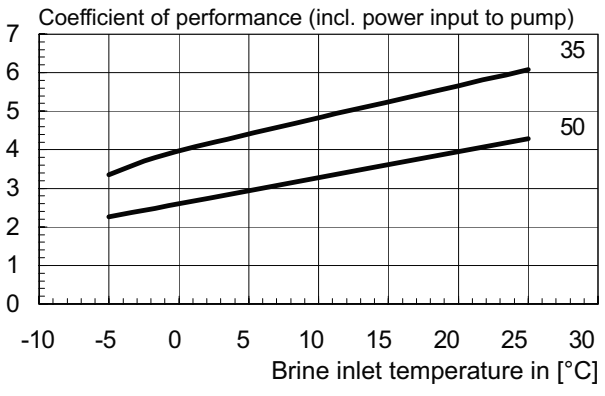


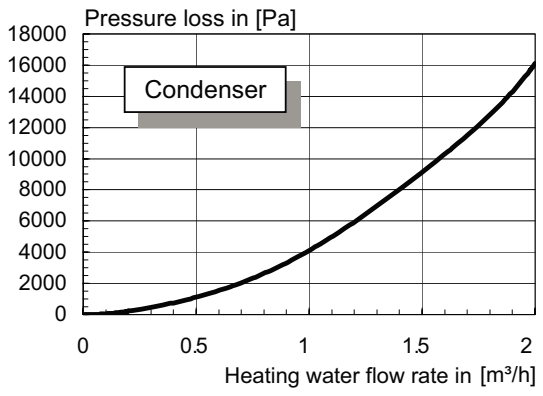
3.7.6 Characteristic curves SI 11ME



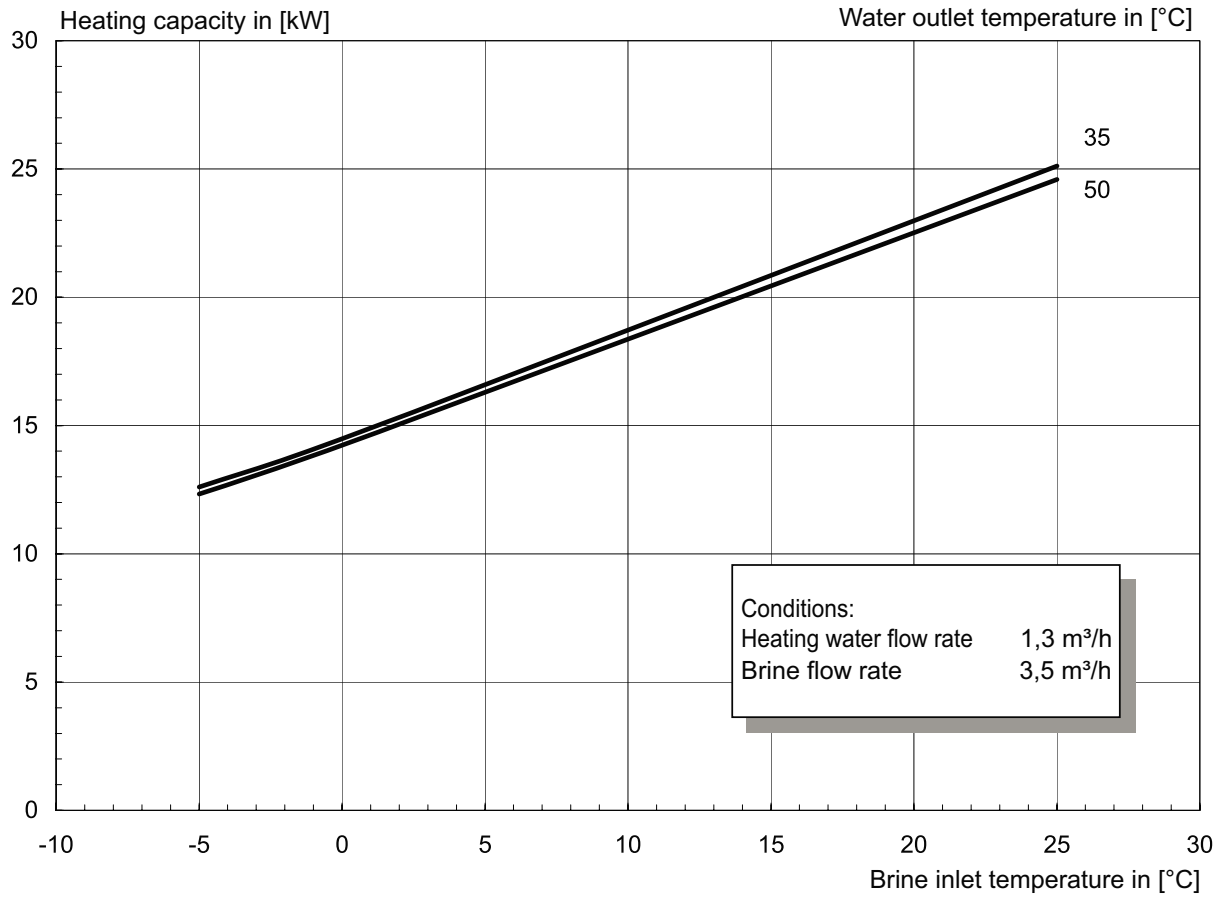


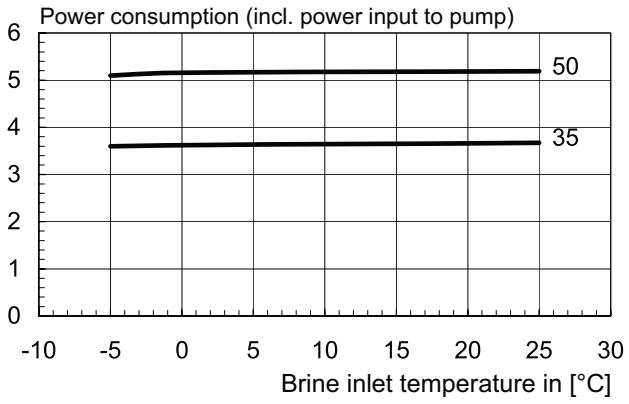


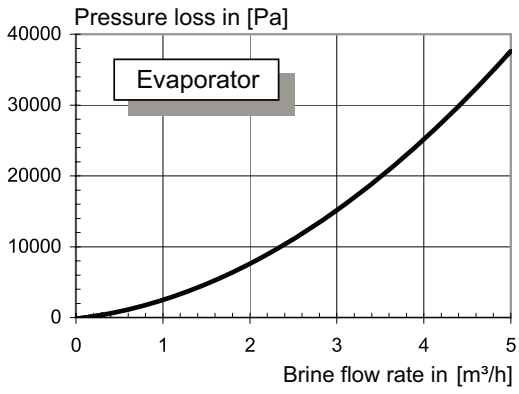


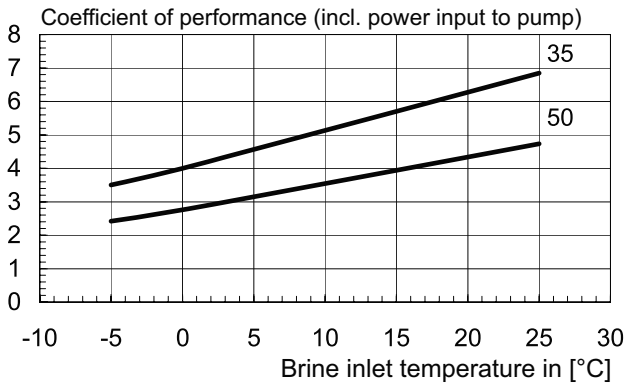


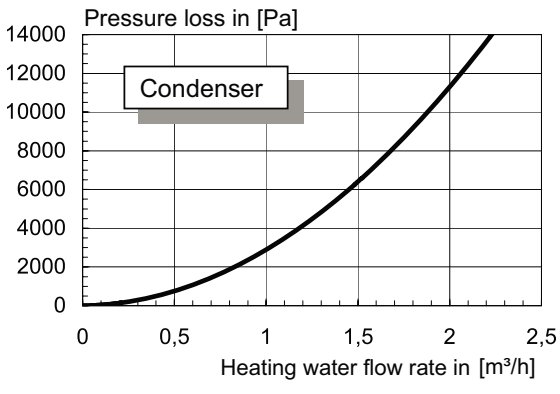
3.7.7 Characteristic curves SI 14ME





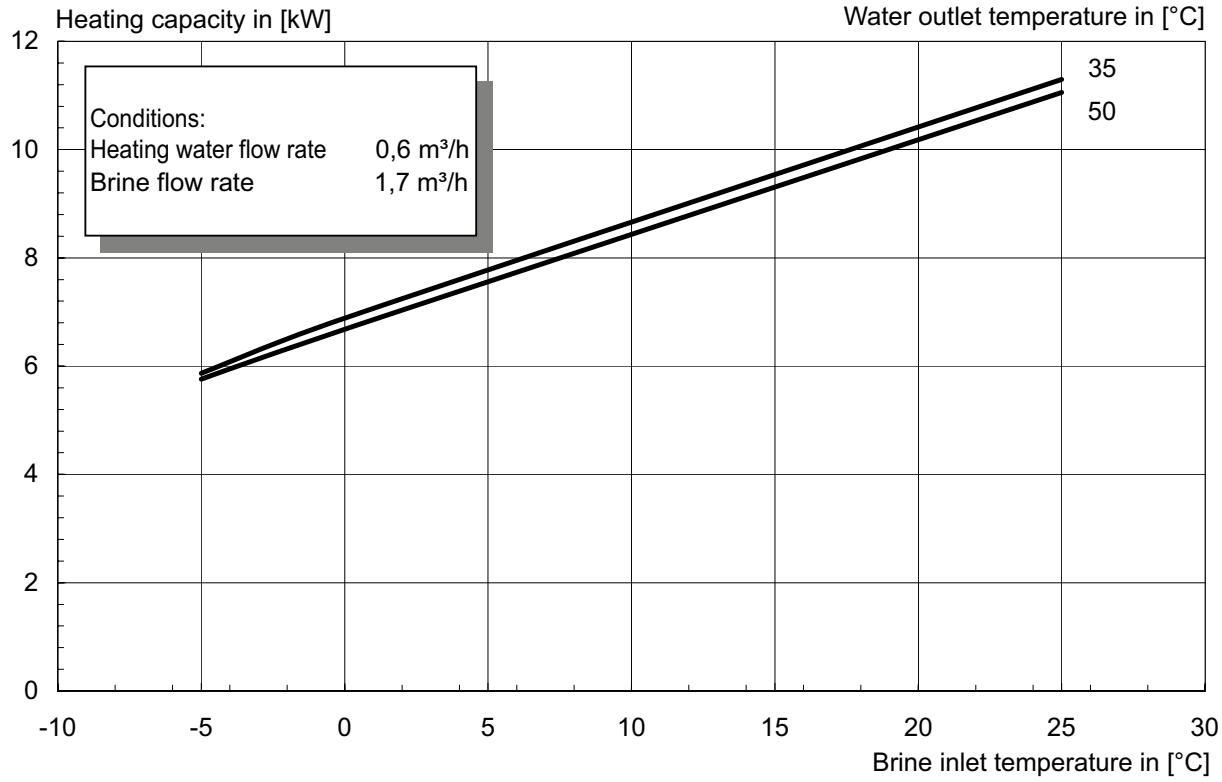


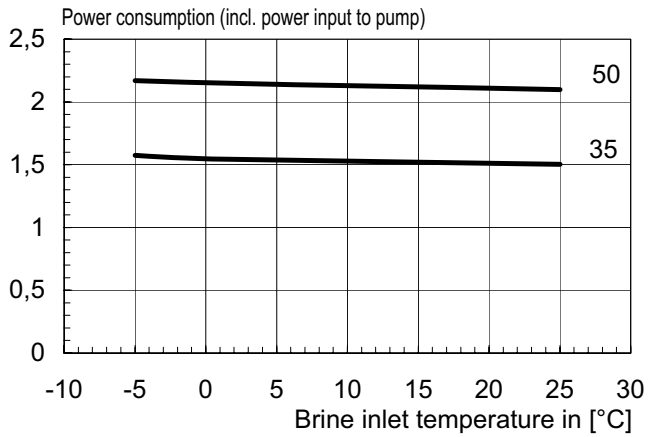


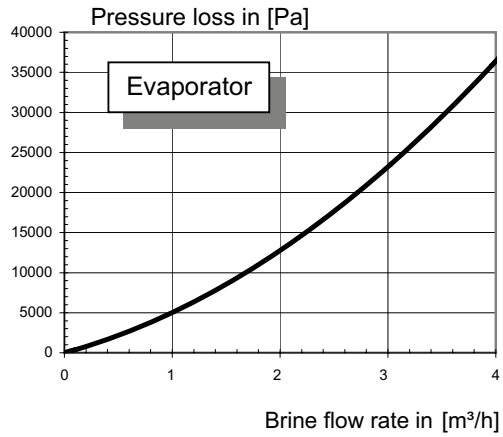


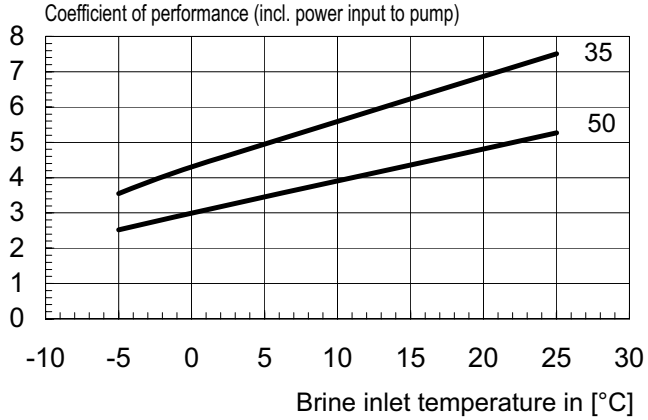
3.8 Characteristic Curves for Brine-to-Water Heat Pumps (3-Phase, 400 V AC)

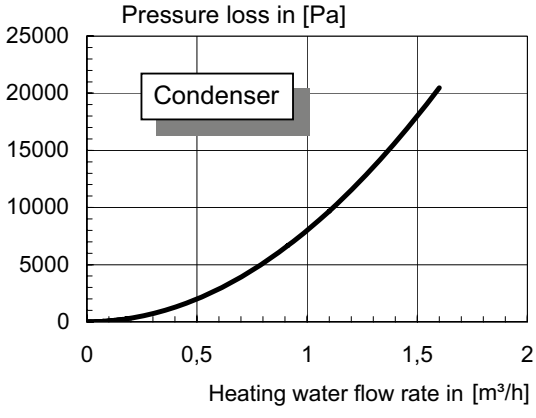
3.8.1 Characteristic curves SIK 7TE



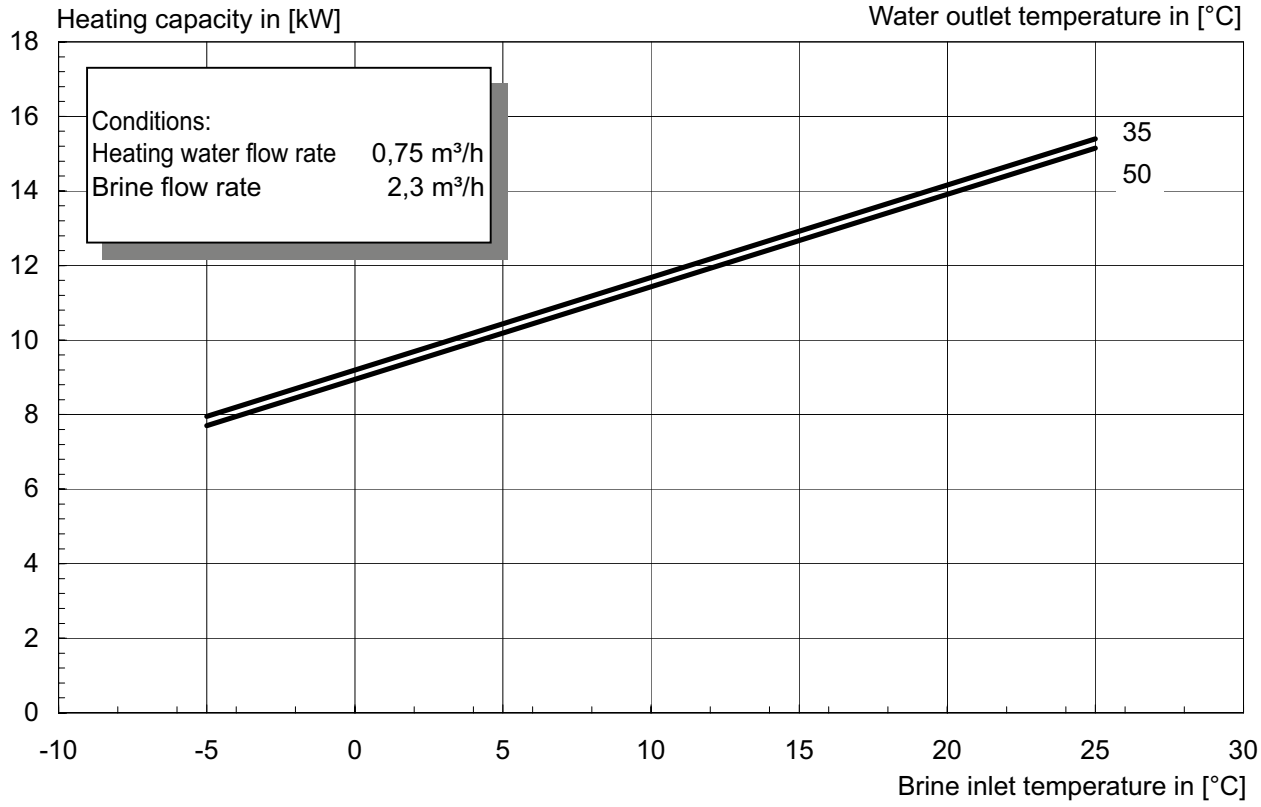


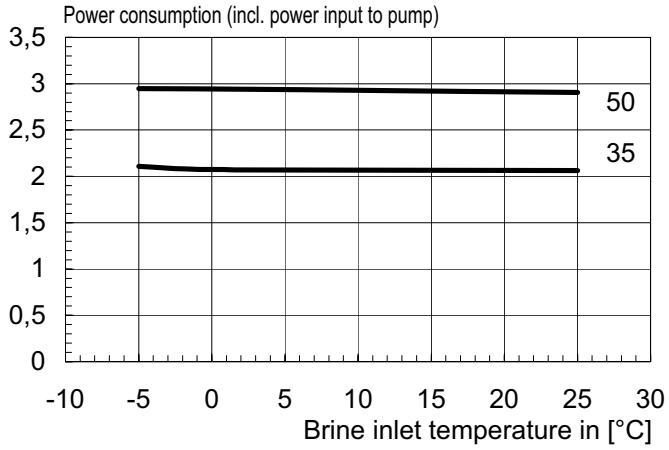


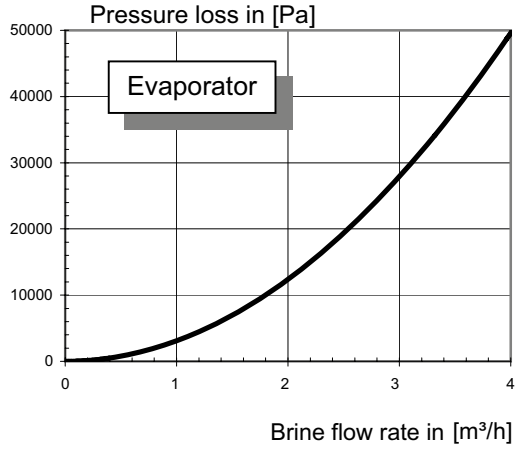


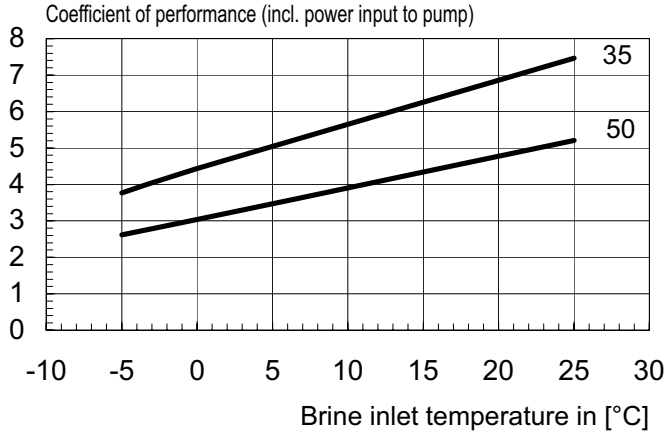


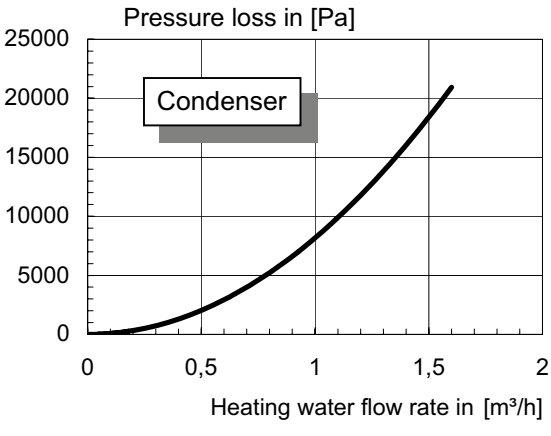
3.8.2 Characteristic curves SIK 9TE



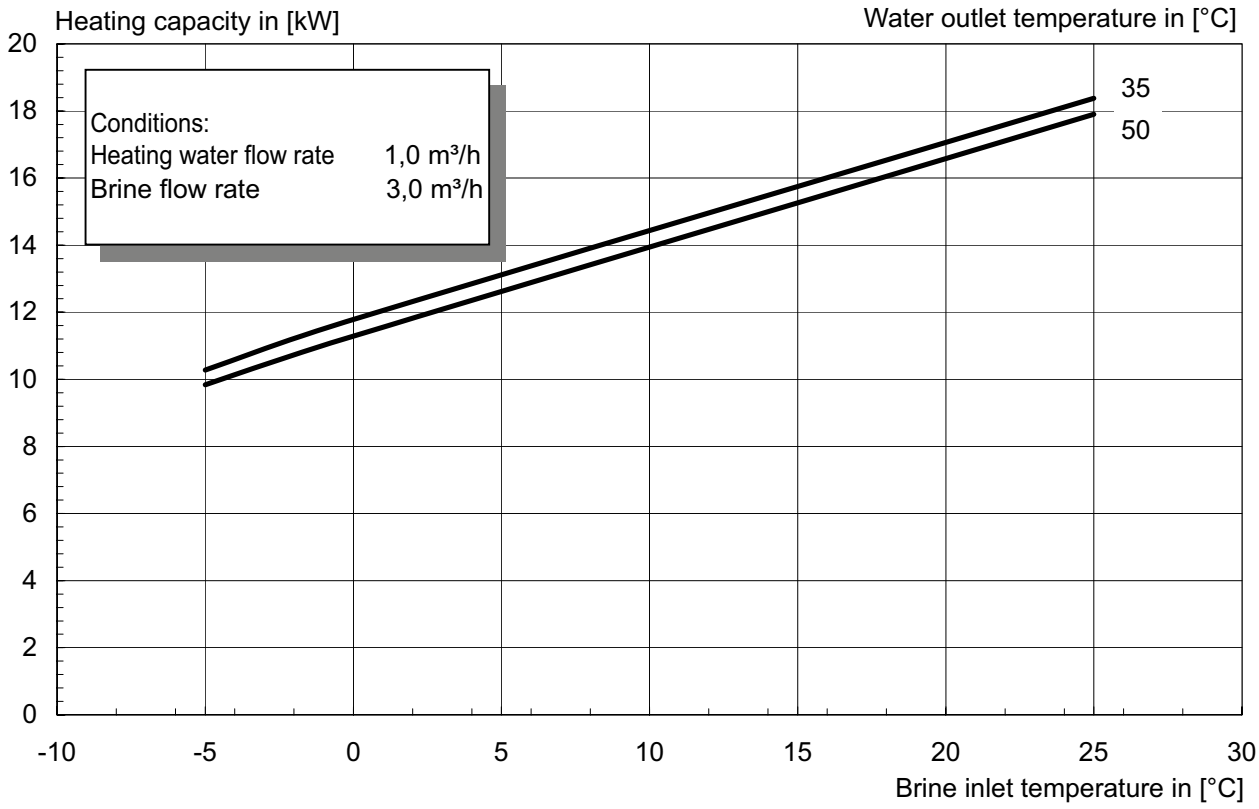


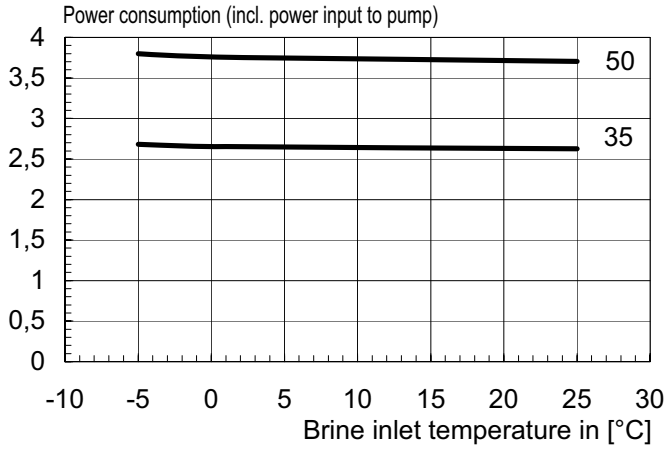


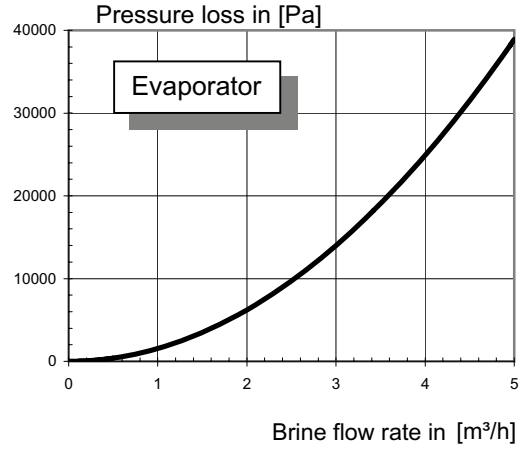


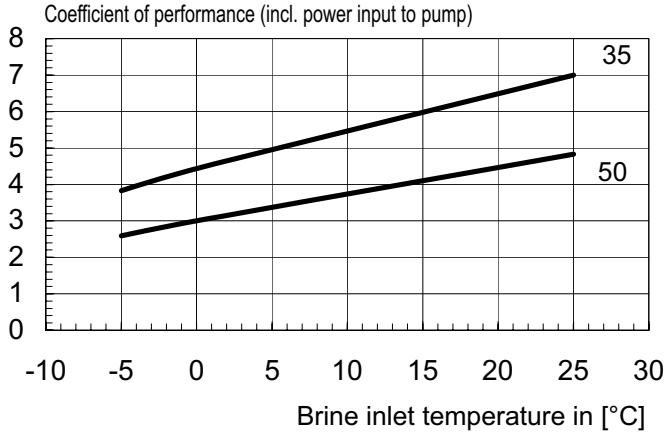


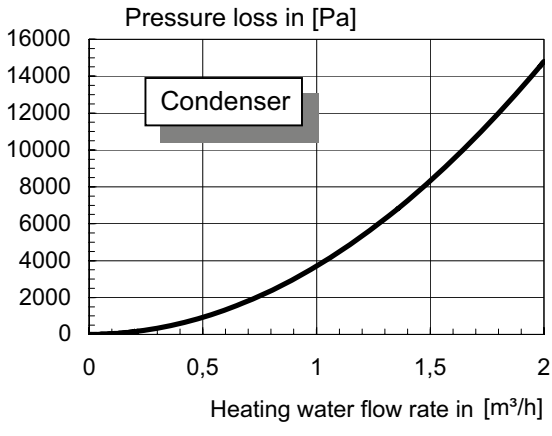
3.8.3 Characteristic curves SIK 11TE



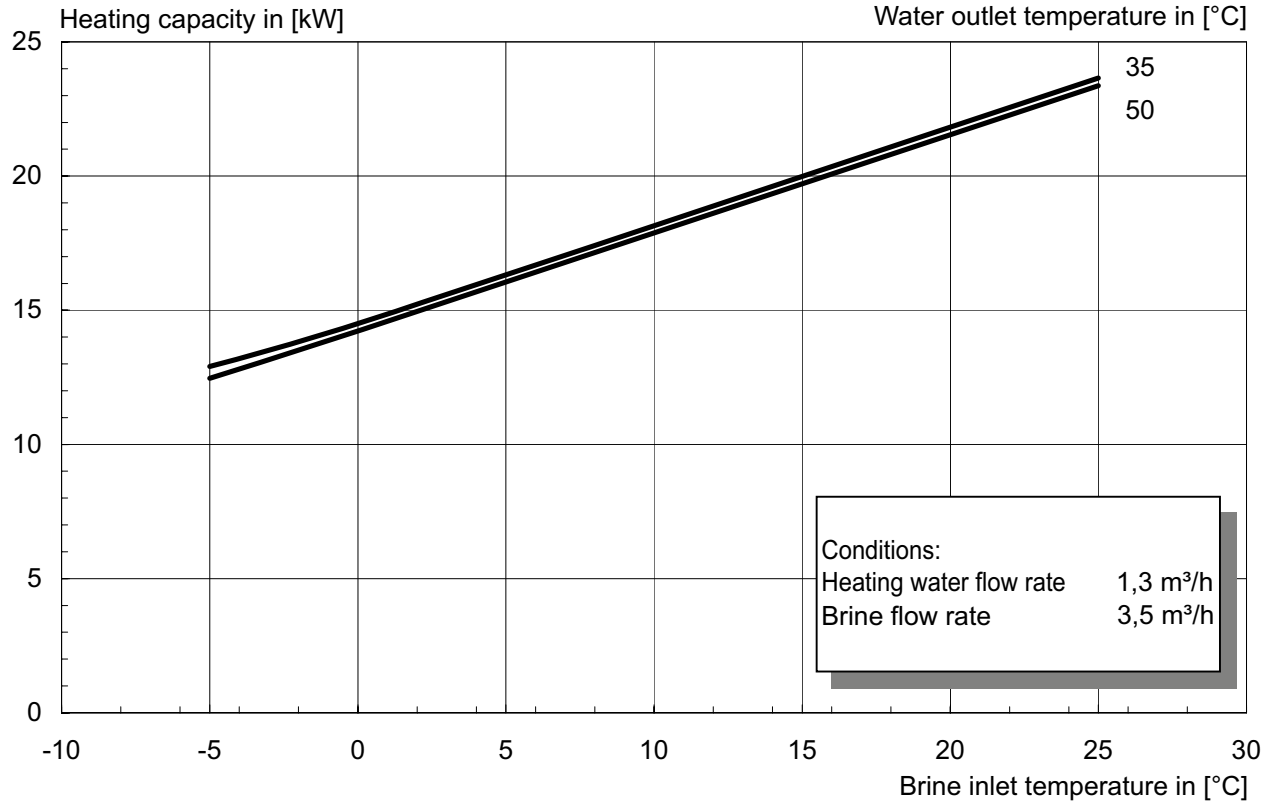


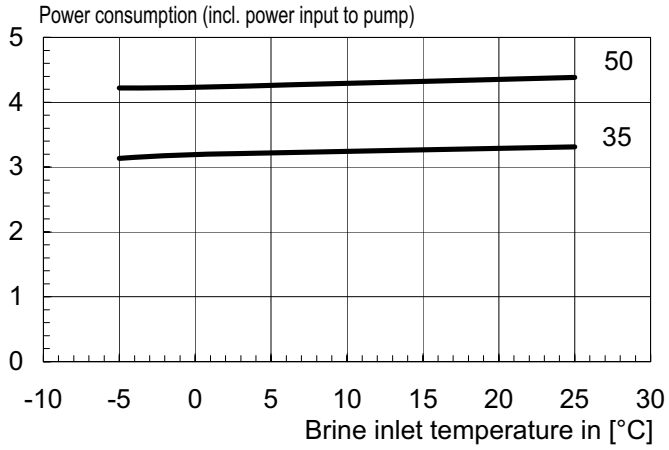


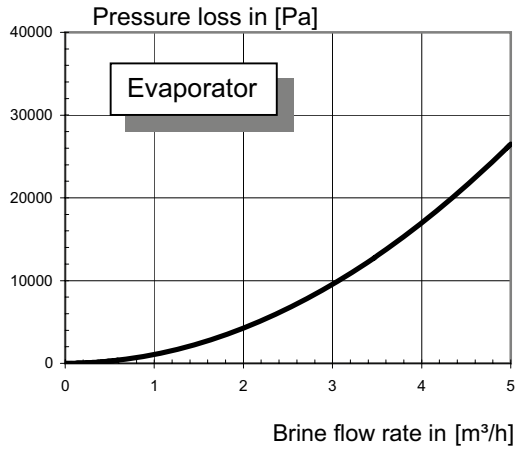


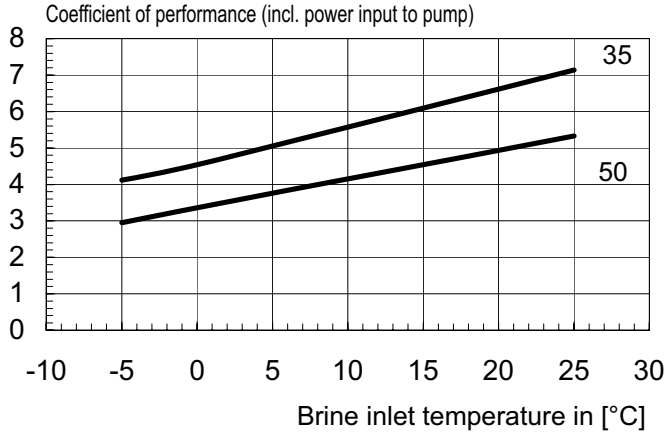


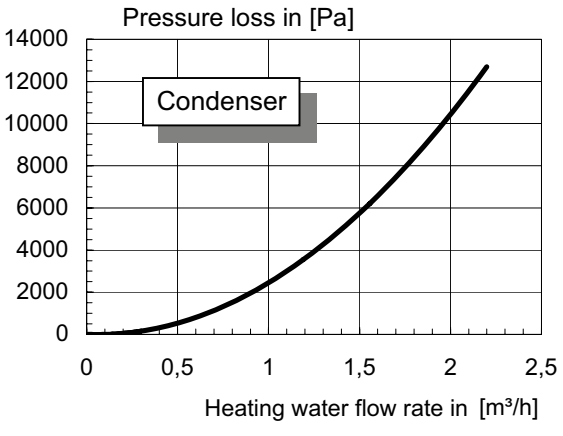
3.8.4 Characteristic curves SIK 14TE



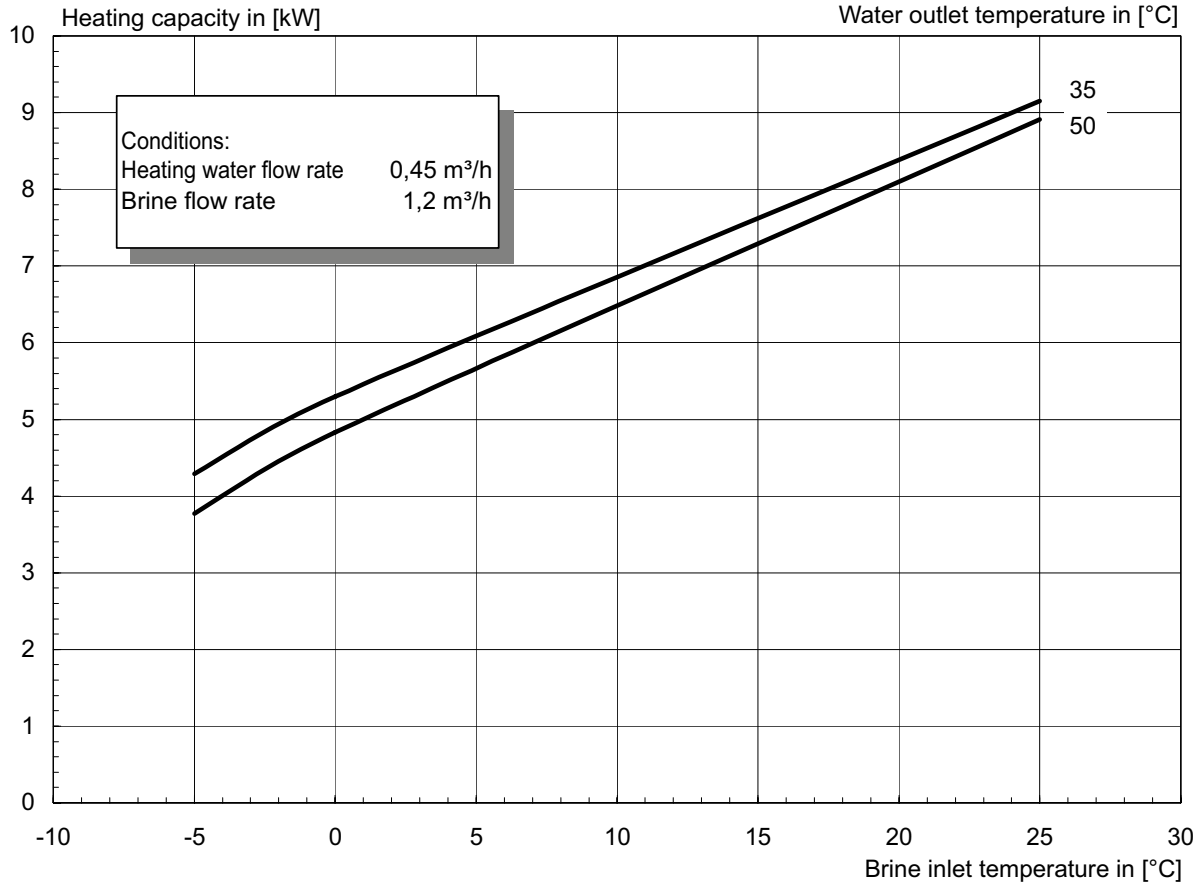


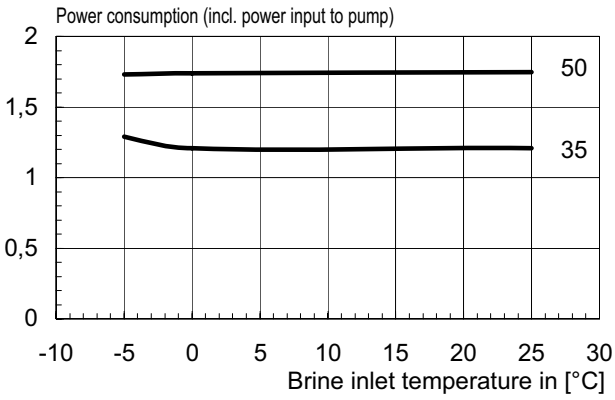


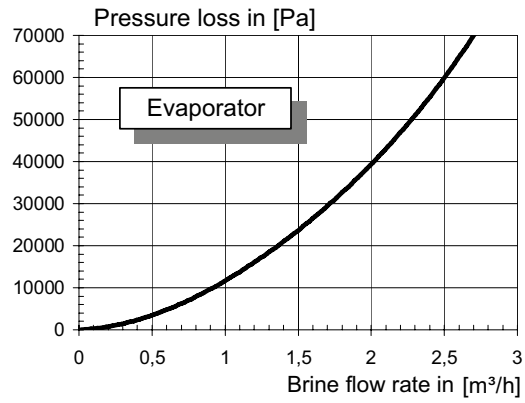


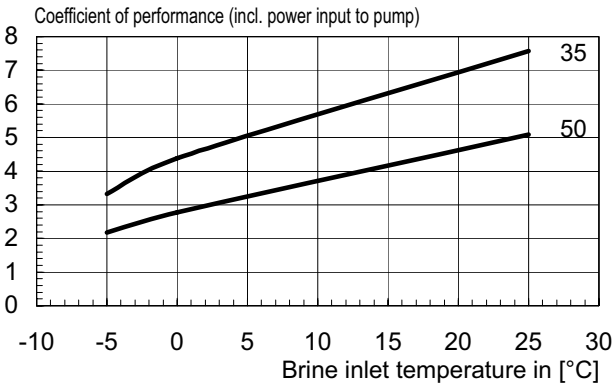


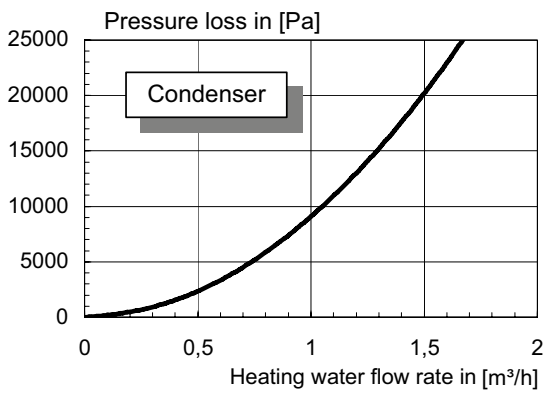
3.8.5 Characteristic curves SI 5TE



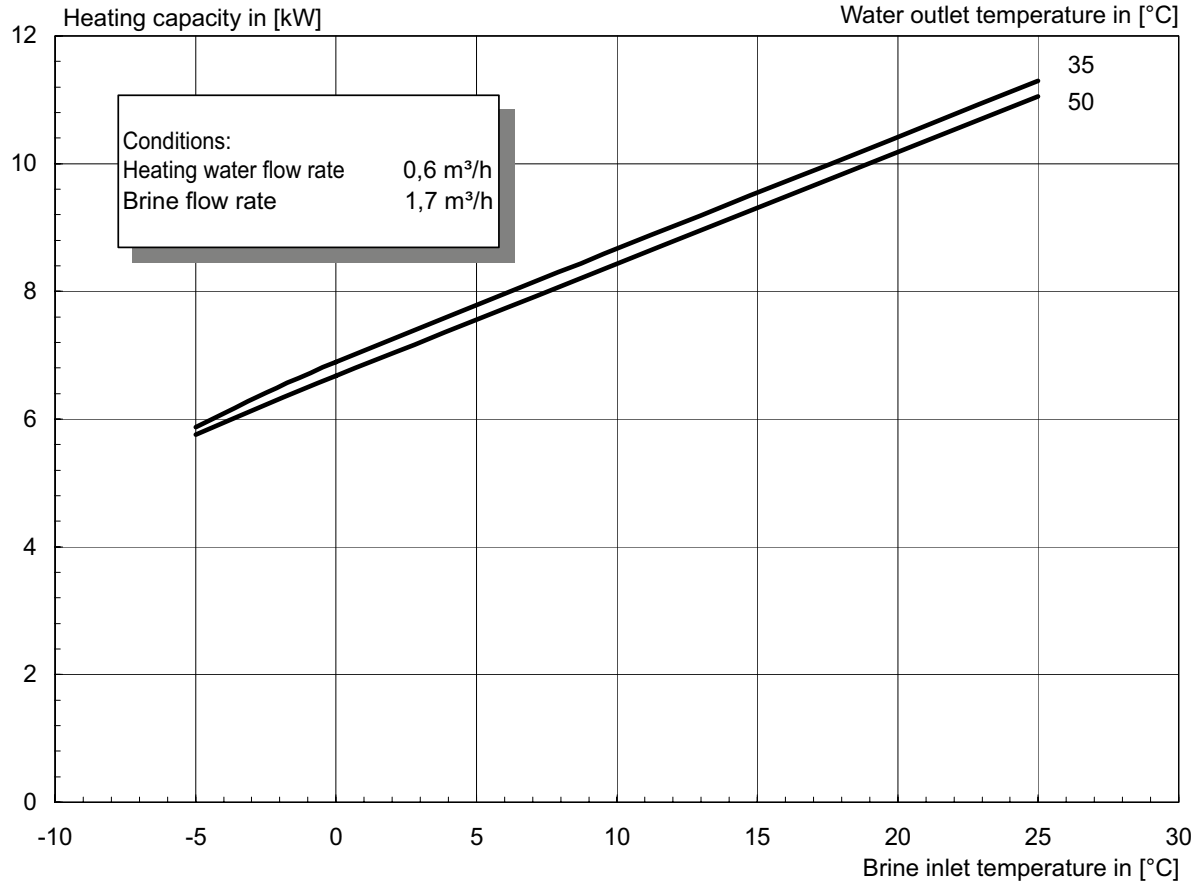


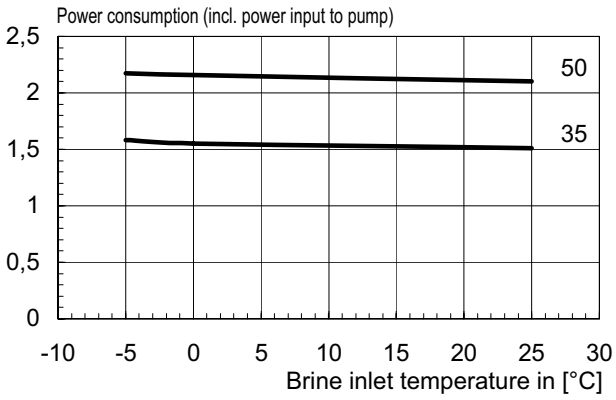


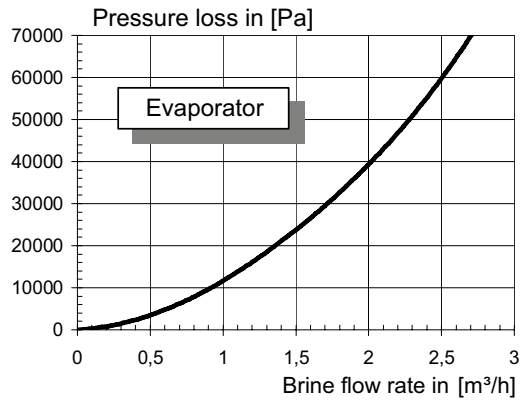


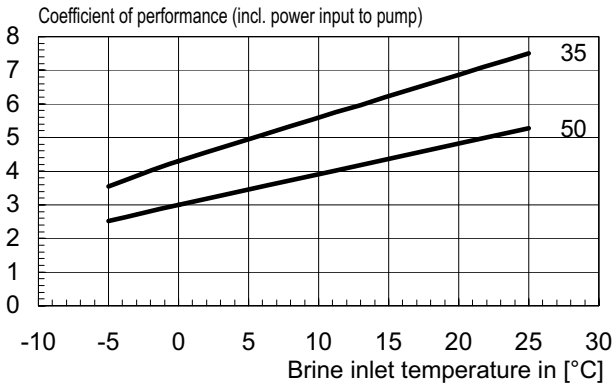


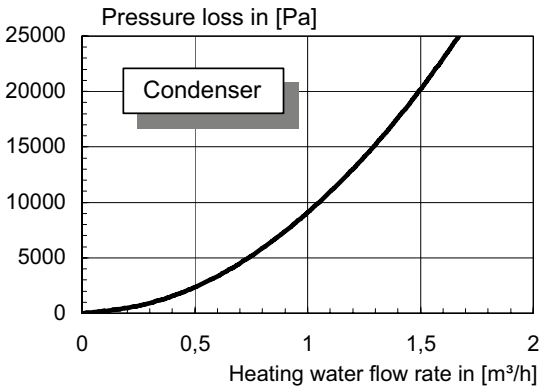
3.8.6 Characteristic curves SI 7TE



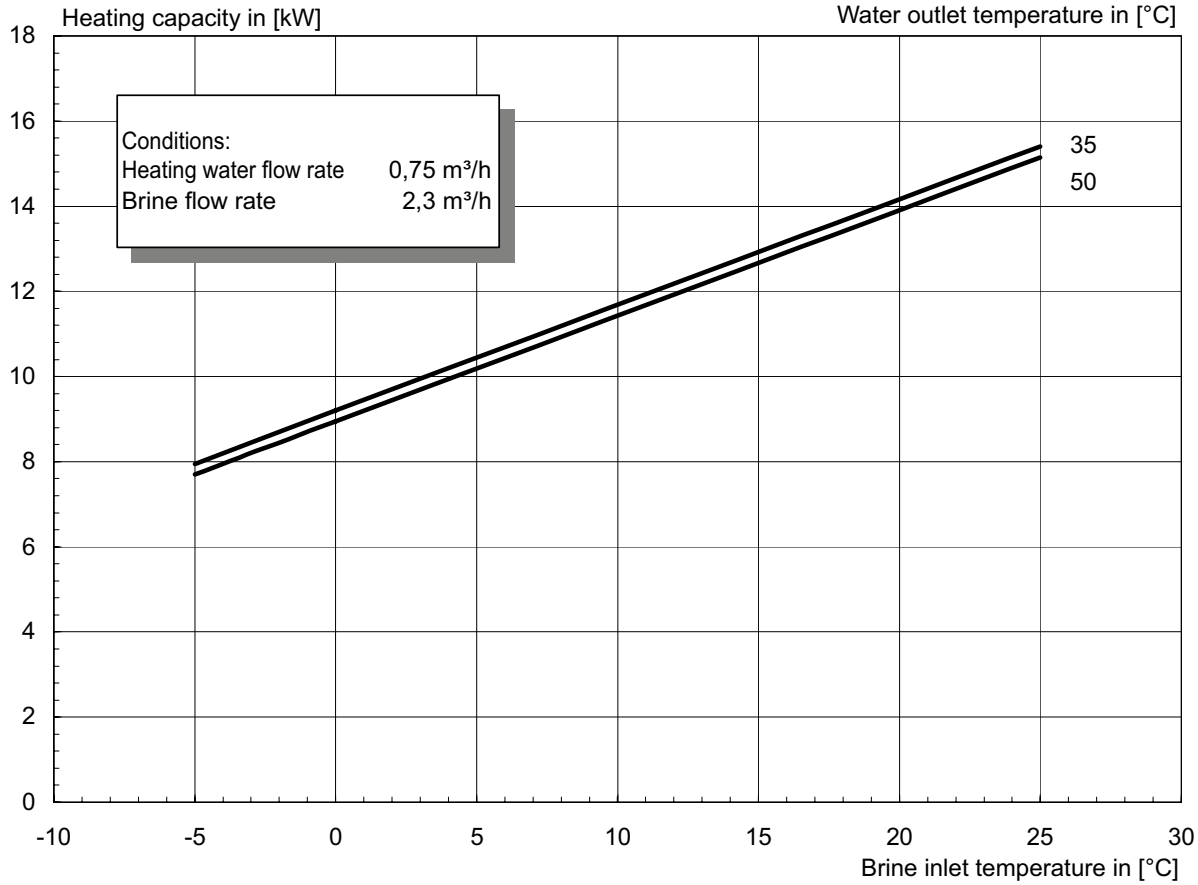


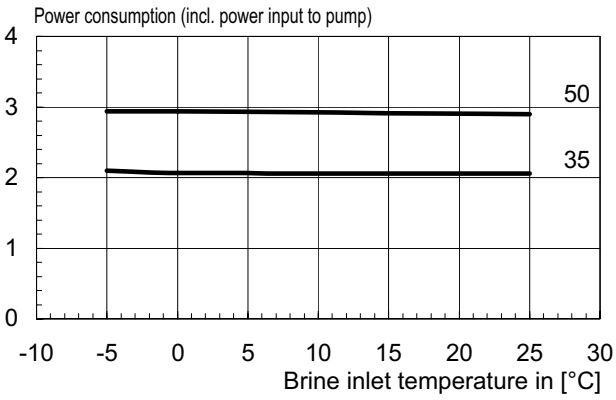


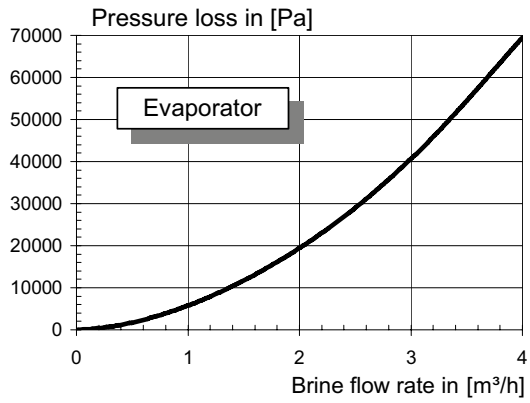


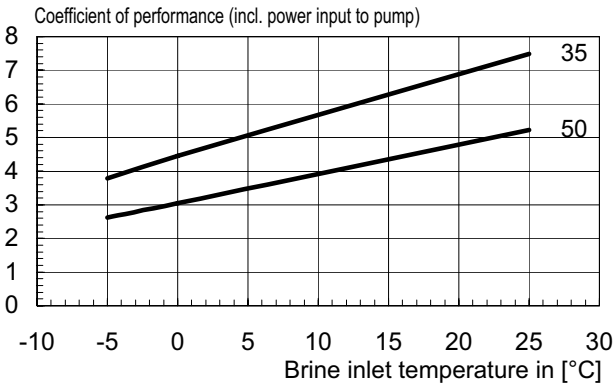


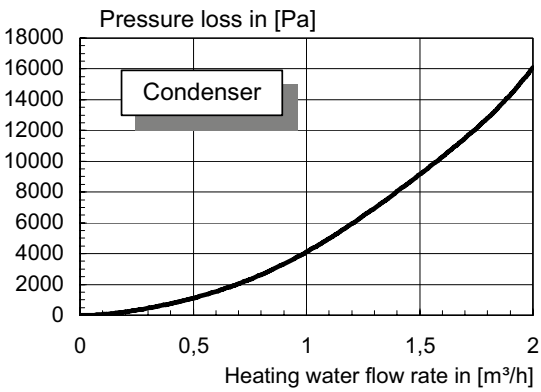
3.8.7 Characteristic curves SI 9TE



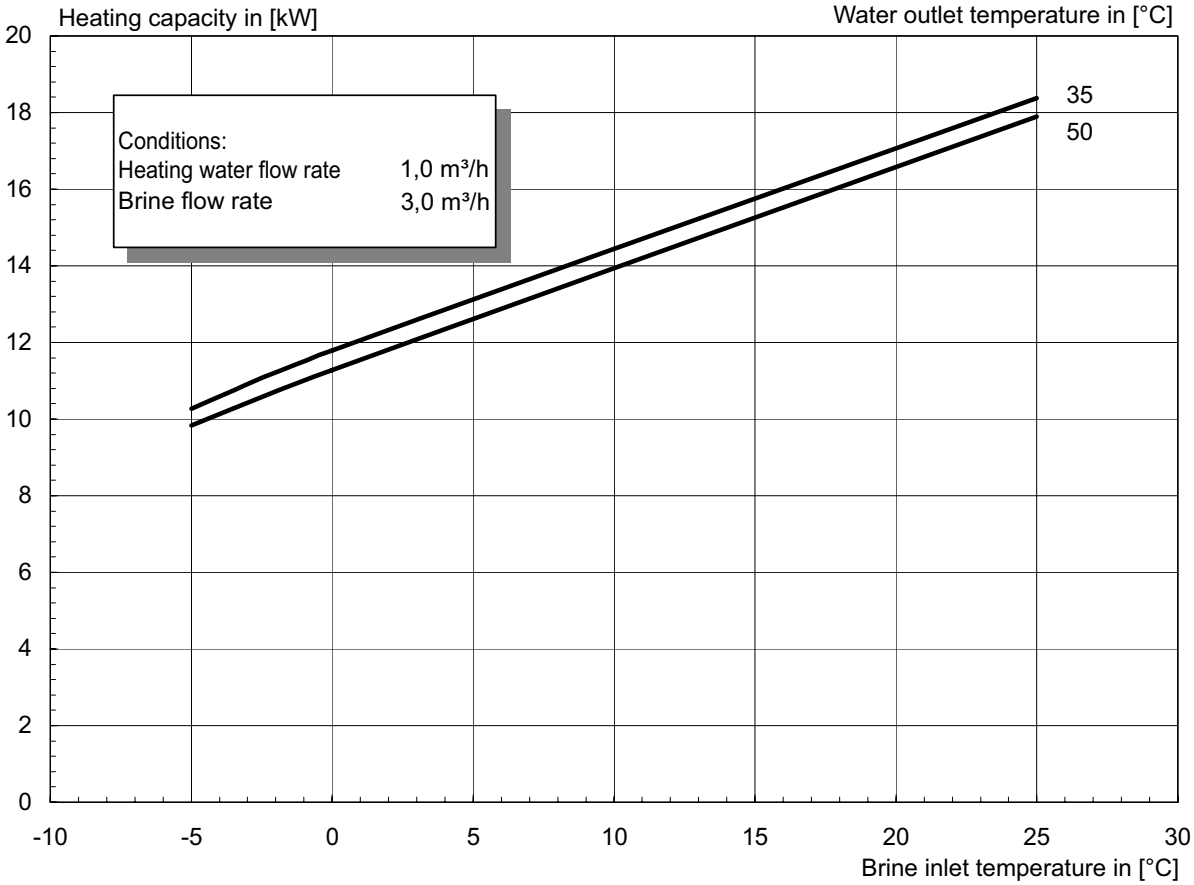


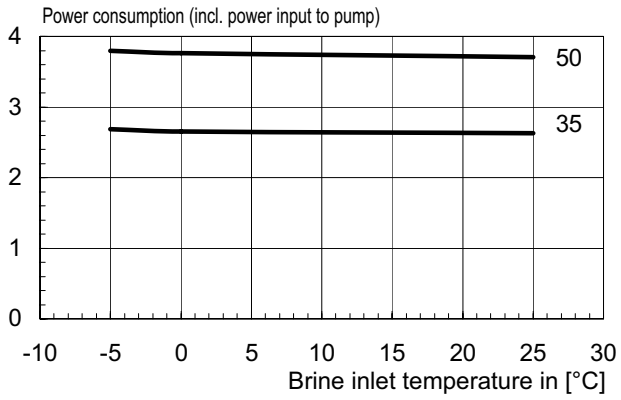


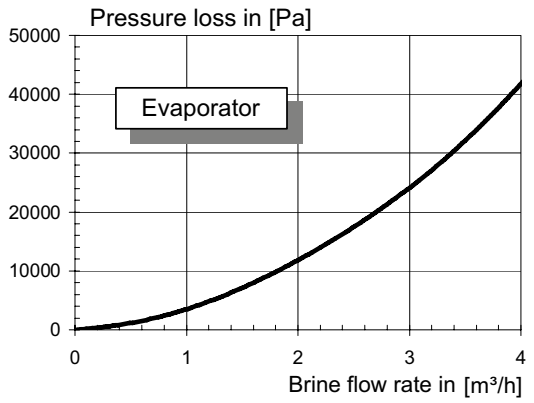


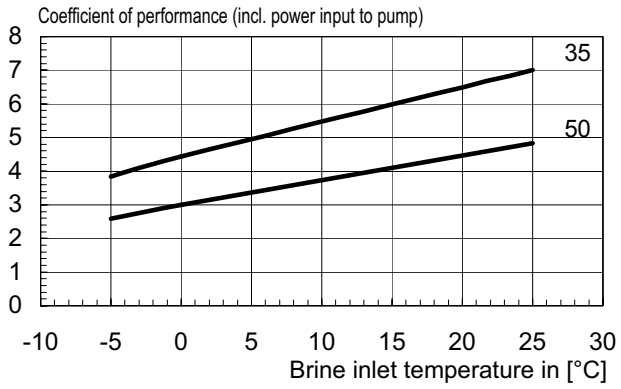


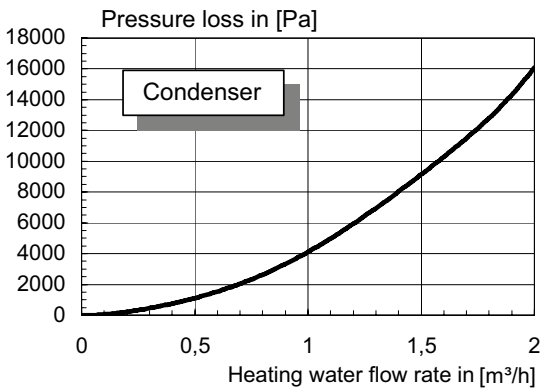
3.8.8 Characteristic curves SI 11TE



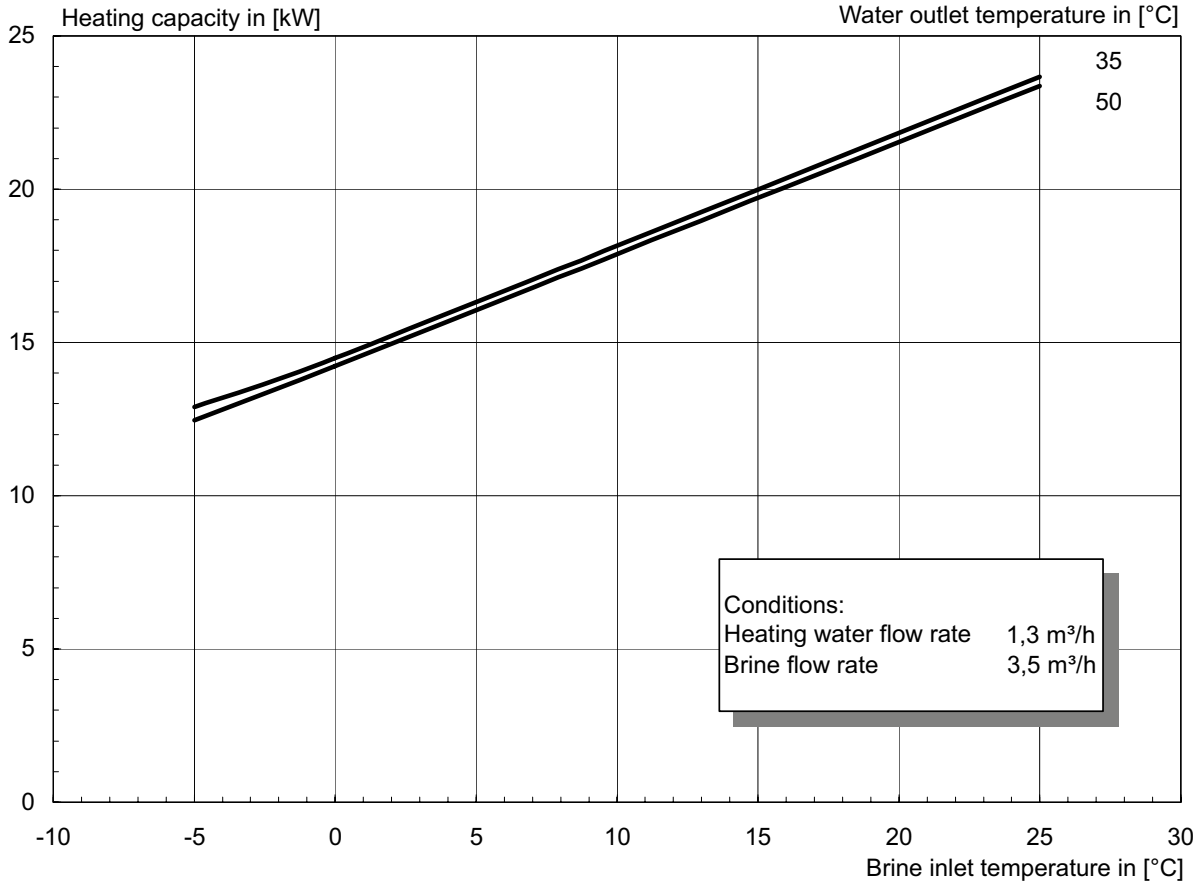


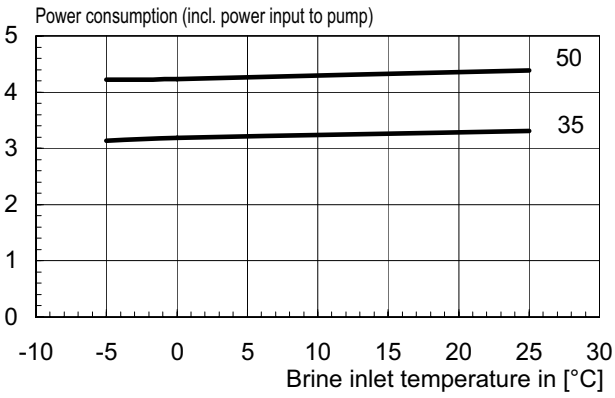


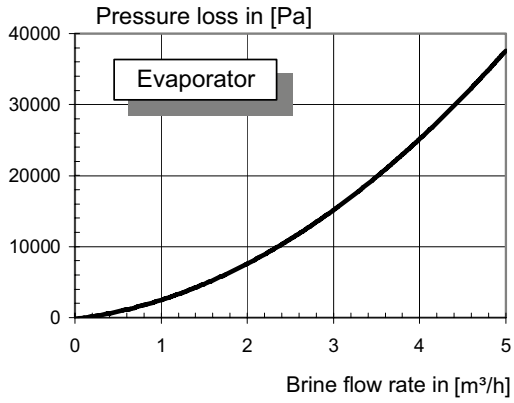


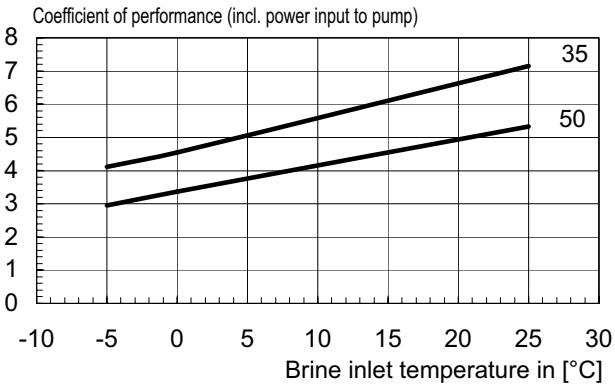


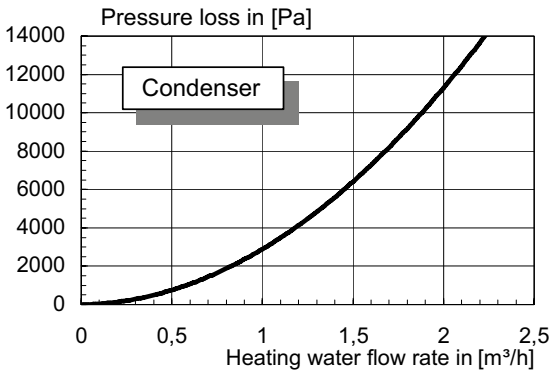
3.8.9 Characteristic curves SI 14TE



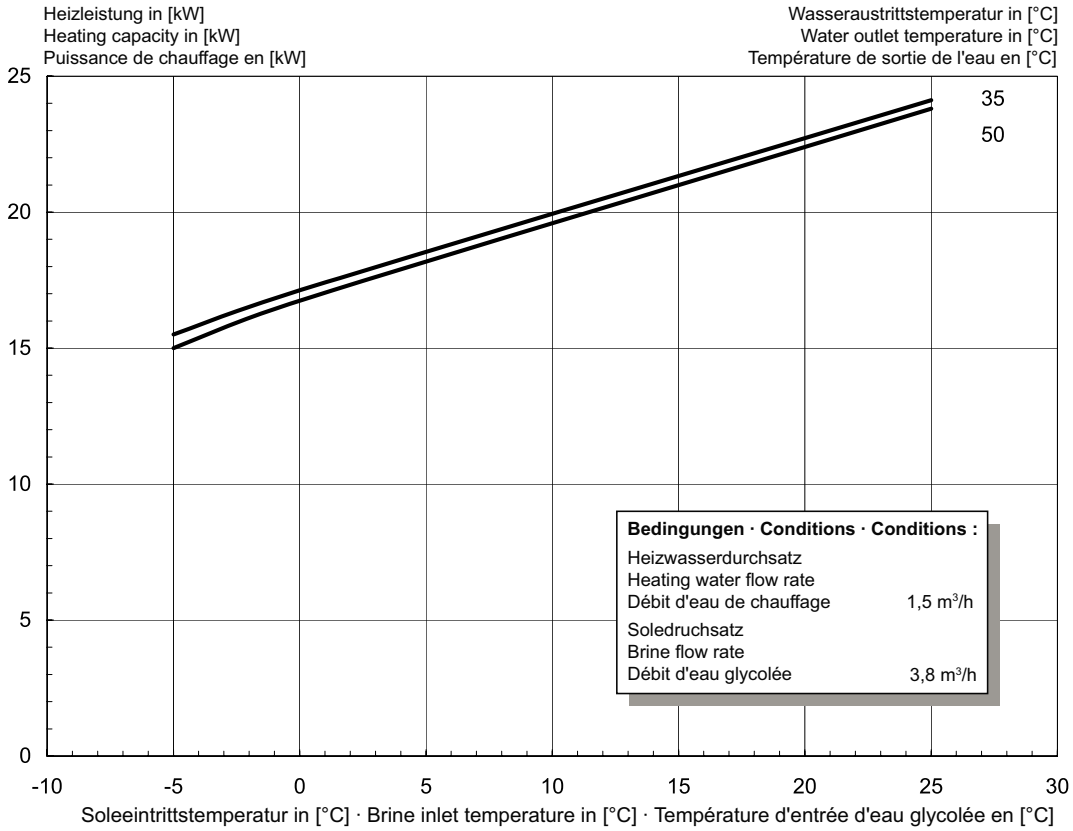


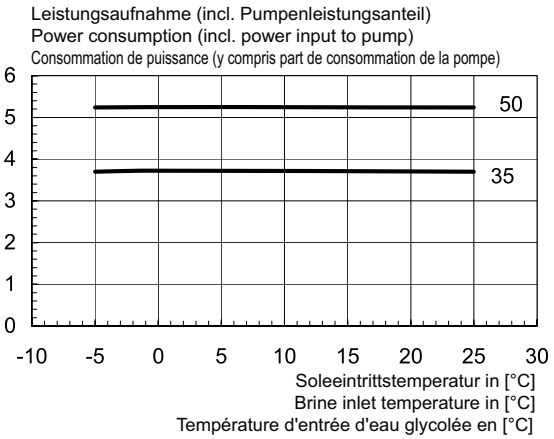


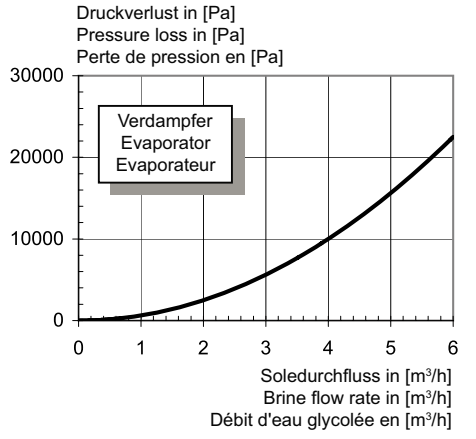


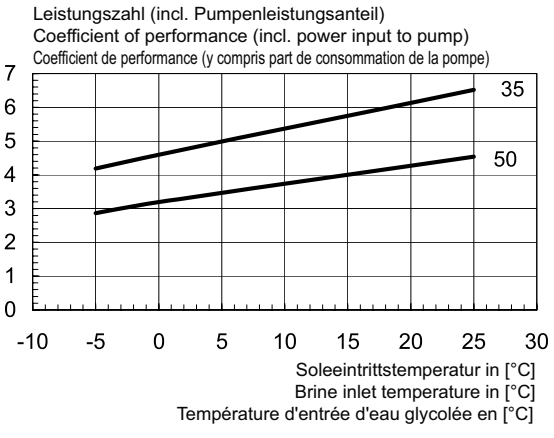


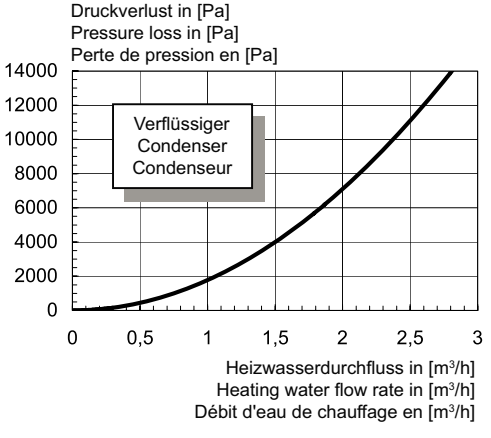
3.8.10 Characteristic curves SI 17TE


Heizleistung in [kW]
Heating capacity in [kW]
Puissance de chauffage en [kW]
Wasseraustrittstemperatur in [°C]
Water outlet temperature in [°C]
Température de sortie de l'eau en [°C]
35
50
Bedingungen · Conditions · Conditions :
Heizwasserdurchsatz
Heating water flow rate
Débit d'eau de chauffage 1,5 m³/h
Soledruchsatz
Brine flow rate
Débit d'eau glycolée 3,8 m³/h
Soleeintrittstemperatur in [°C] · Brine inlet temperature in [°C] · Température d'entrée d'eau glycolée en [°C]

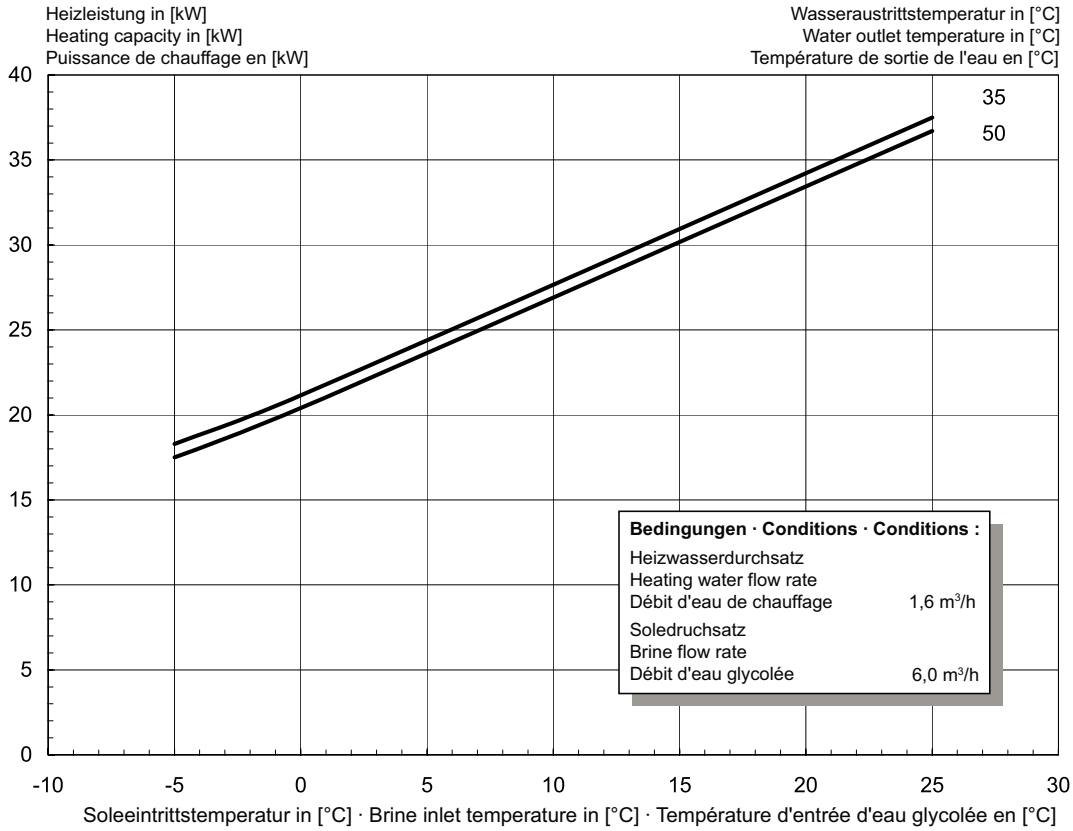

Leistungsaufnahme (incl. Pumpenleistungsanteil)
Power consumption (incl. power input to pump)
Consommation de puissance (y compris part de consommation de la pompe)
50
35
Soleeintrittstemperatur in [°C]
Brine inlet temperature in [°C]
Température d'entrée d'eau glycolée en [°C]

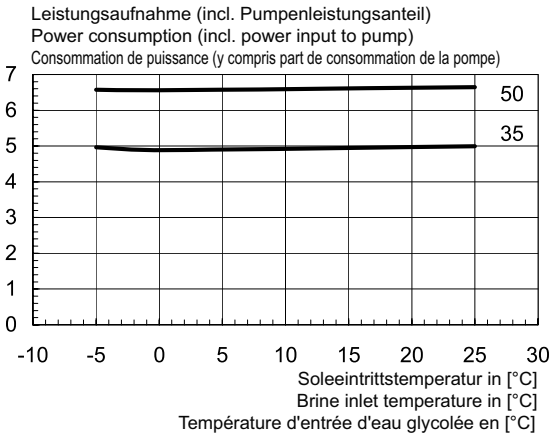


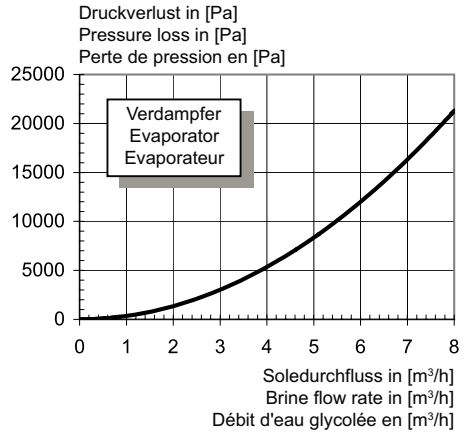

Leistungszahl (incl. Pumpenleistungsanteil)
Coefficient of performance (incl. power input to pump)
Coefficient de performance (y compris part de consommation de la pompe)
35
50
Soleeintrittstemperatur in [°C]
Brine inlet temperature in [°C]
Température d'entrée d'eau glycolée en [°C]

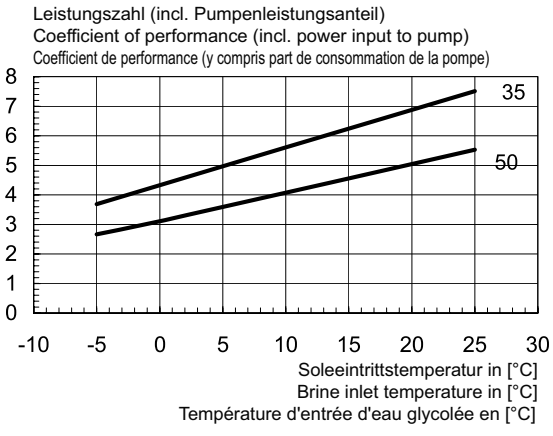


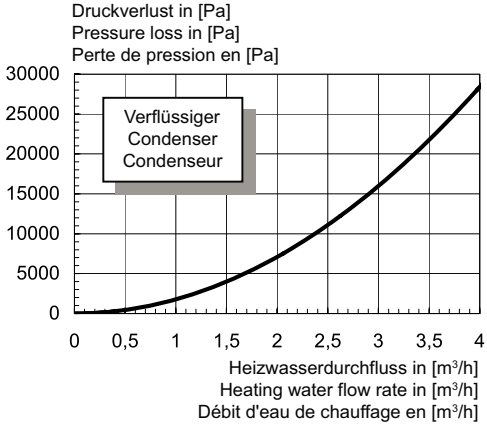
3.8.11 Characteristic curves SI 21TE


Heizleistung in [kW]
Heating capacity in [kW]
Puissance de chauffage en [kW]
Wasseraustrittstemperatur in [°C]
Water outlet temperature in [°C]
Température de sortie de l'eau en [°C]
35
50
Bedingungen · Conditions · Conditions :
Heizwasserdurchsatz
Heating water flow rate
Débit d'eau de chauffage 1,6 m³/h
Soledruchsatz
Brine flow rate
Débit d'eau glycolée 6,0 m³/h
Soleeintrittstemperatur in [°C] · Brine inlet temperature in [°C] · Température d'entrée d'eau glycolée en [°C]

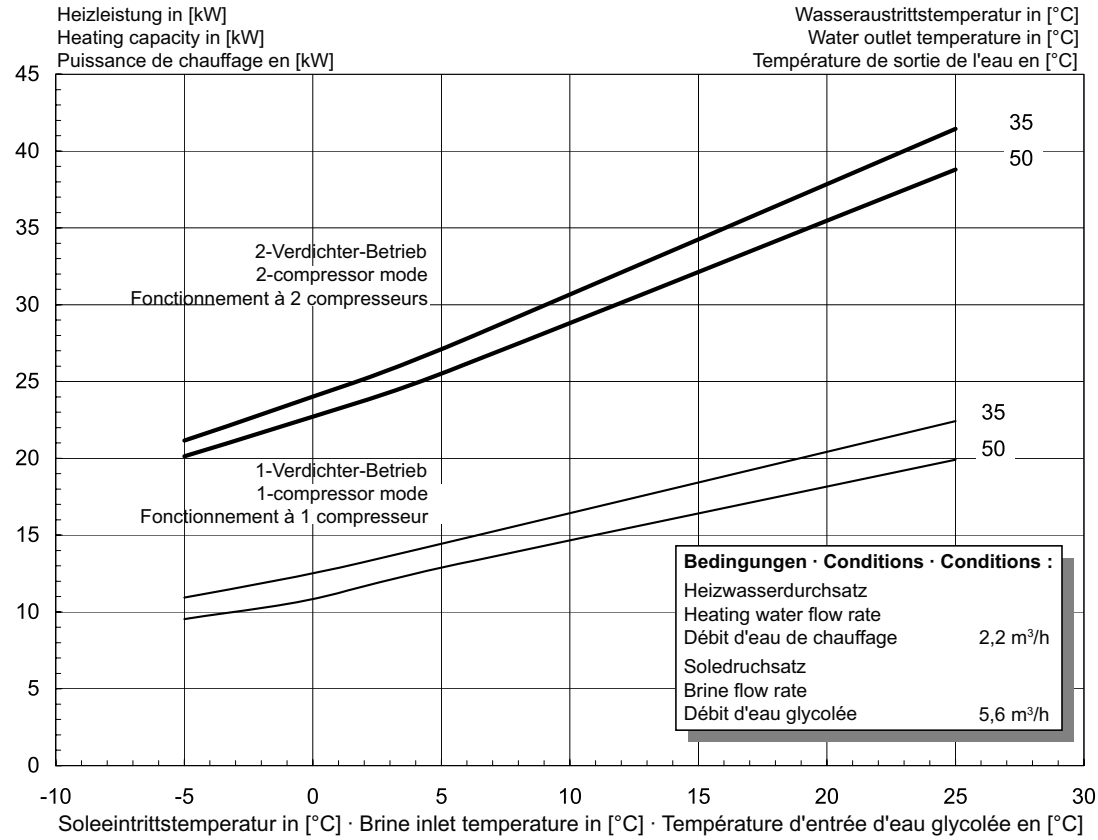

Leistungsaufnahme (incl. Pumpenleistungsanteil)
Power consumption (incl. power input to pump)
Consommation de puissance (y compris part de consommation de la pompe)
50
35
Soleeintrittstemperatur in [°C]
Brine inlet temperature in [°C]
Température d'entrée d'eau glycolée en [°C]

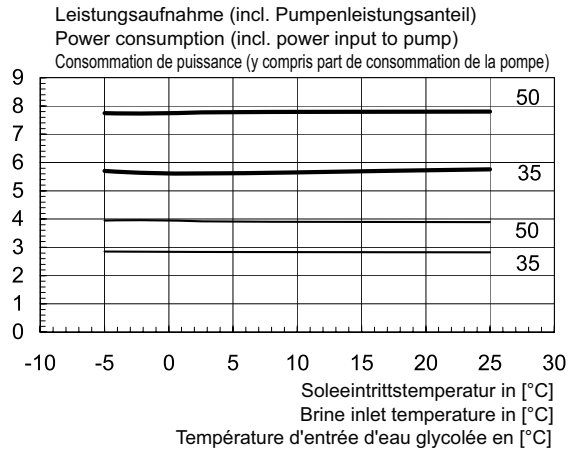


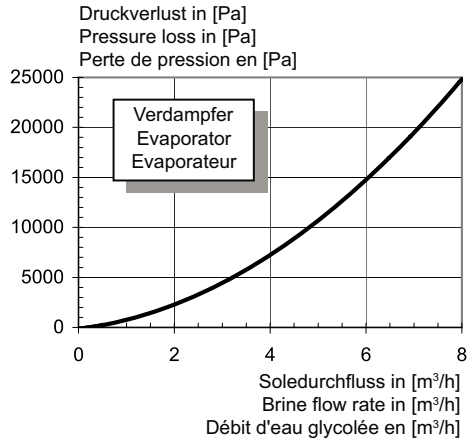

Leistungszahl (incl. Pumpenleistungsanteil)
Coefficient of performance (incl. power input to pump)
Coefficient de performance (y compris part de consommation de la pompe)
35
50
Soleeintrittstemperatur in [°C]
Brine inlet temperature in [°C]
Température d'entrée d'eau glycolée en [°C]

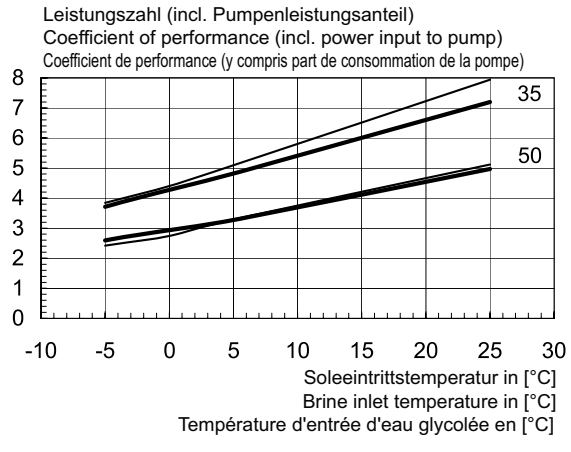


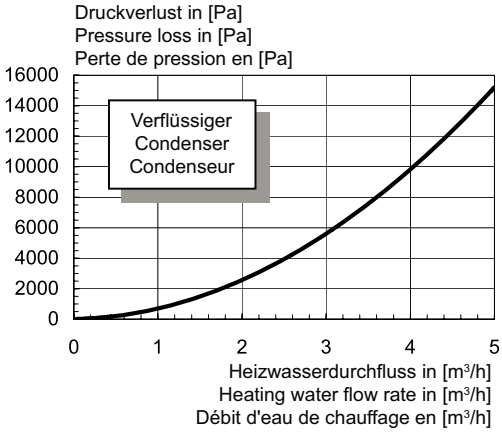
3.8.12 Characteristic curves SI 24TE



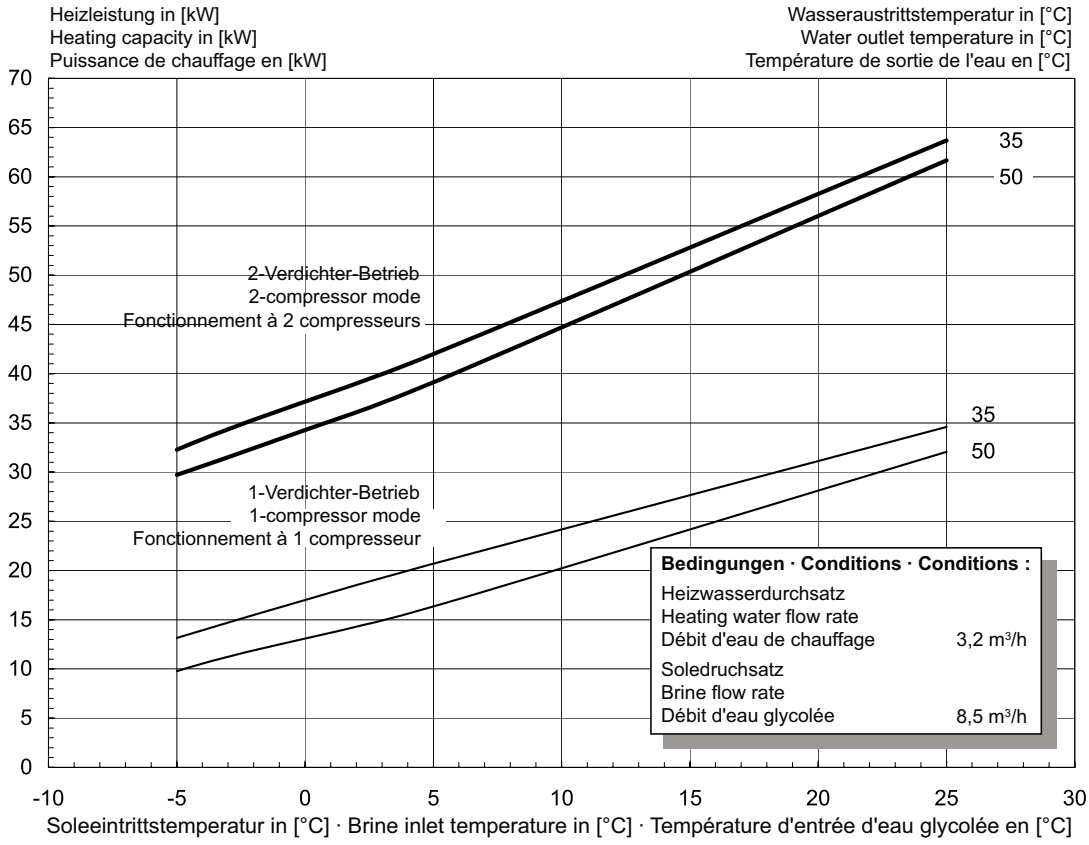


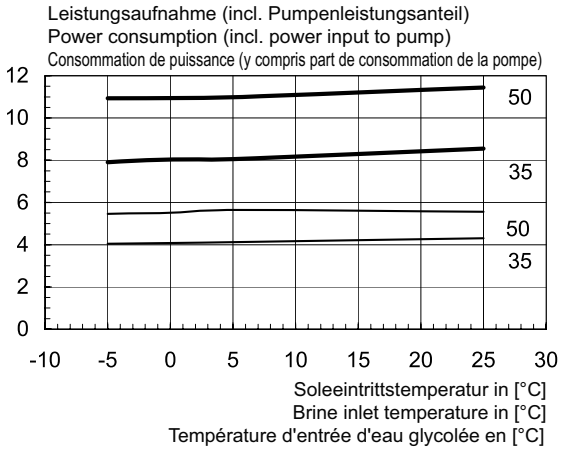


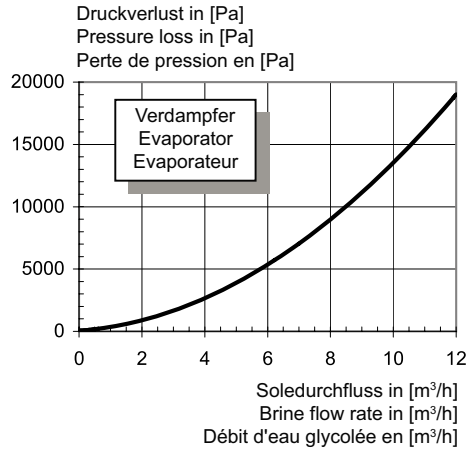


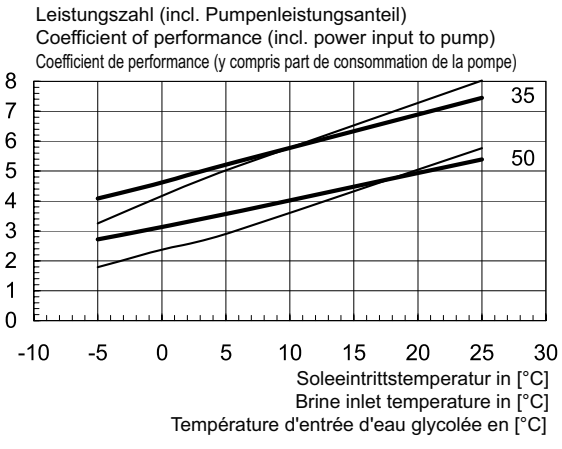


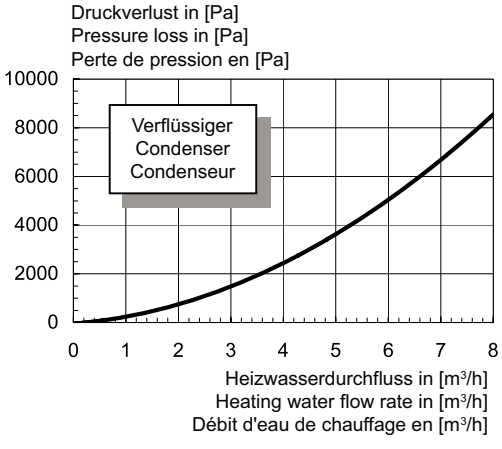
3.8.13 Characteristic curves SI 37TE



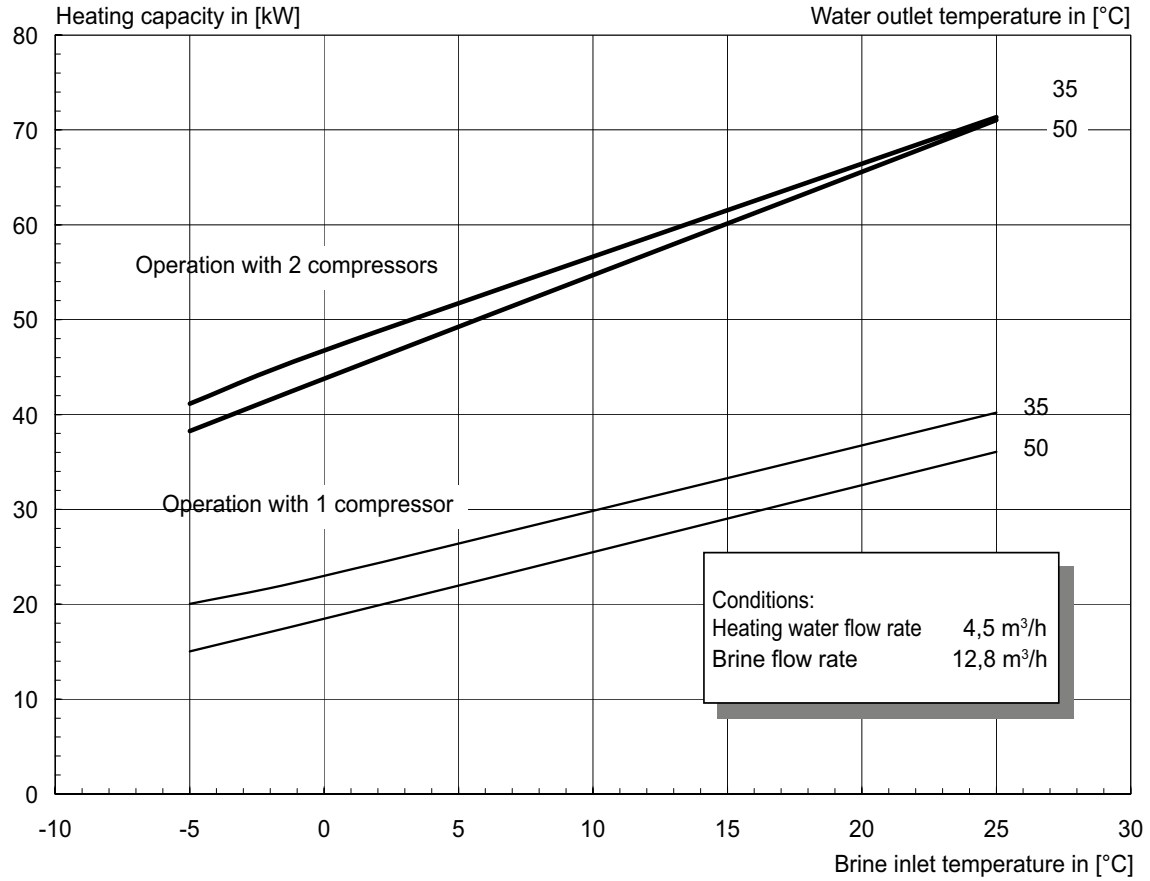


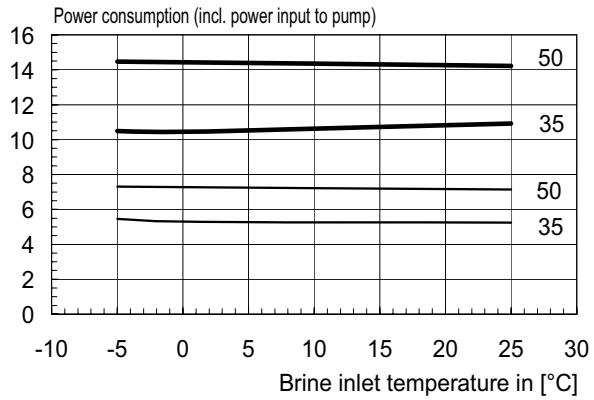


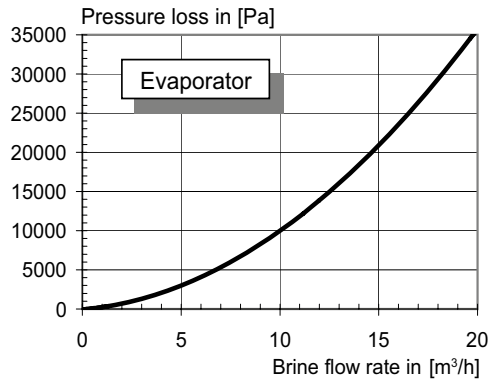

Leistungszahl (incl. Pumpenleistungsanteil)
Coefficient of performance (incl. power input to pump)
Coefficient de performance (y compris part de consommation de la pompe)
35
50
Soleeintrittstemperatur in [°C]
Brine inlet temperature in [°C]
Température d'entrée d'eau glycolée en [°C]

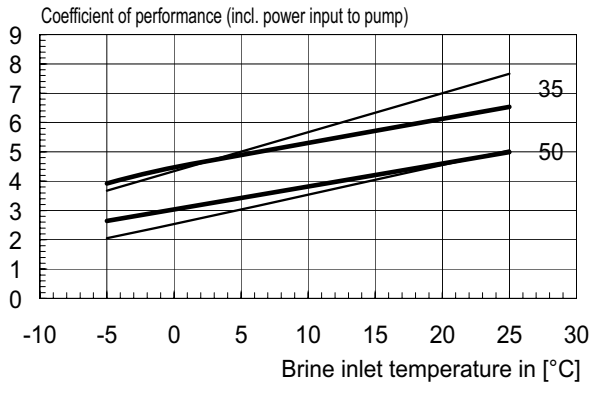


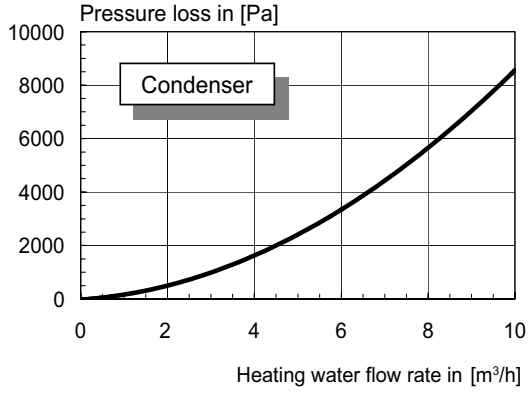
3.8.14 Characteristic curves SI 50TE



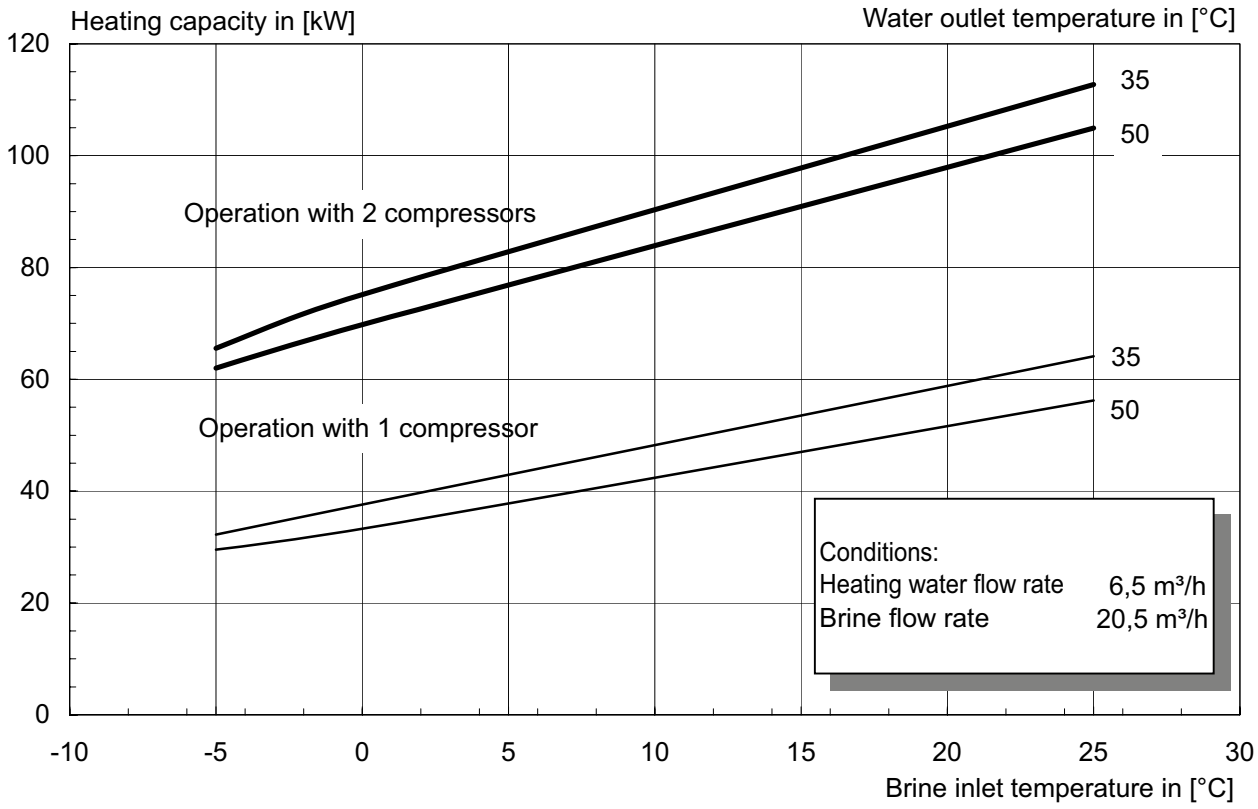


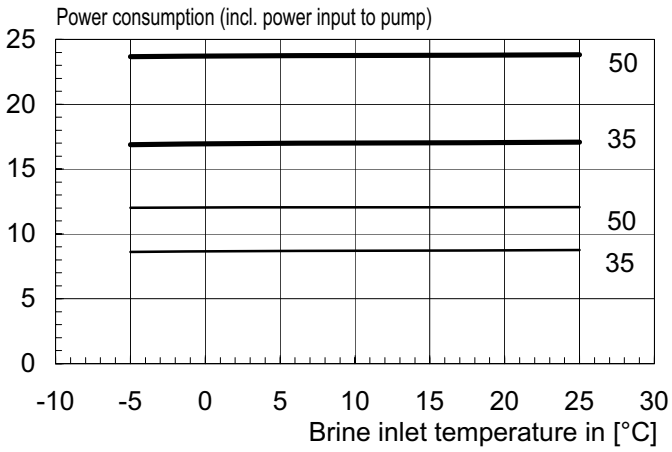


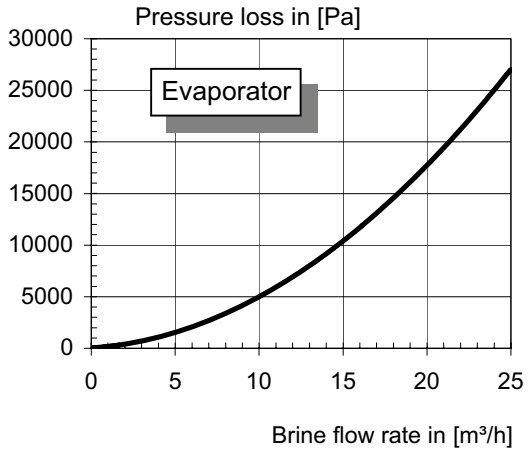


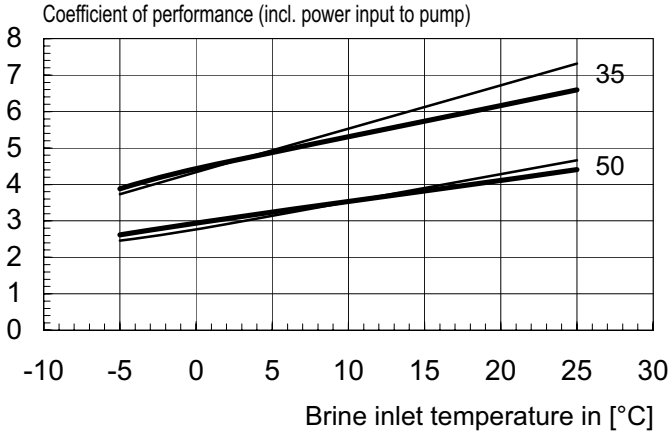


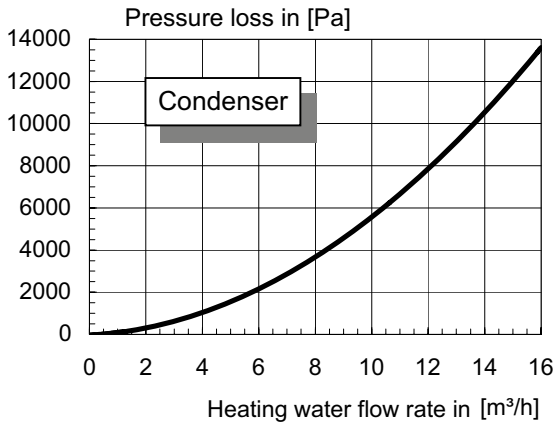
3.8.15 Characteristic curves SI 75TE



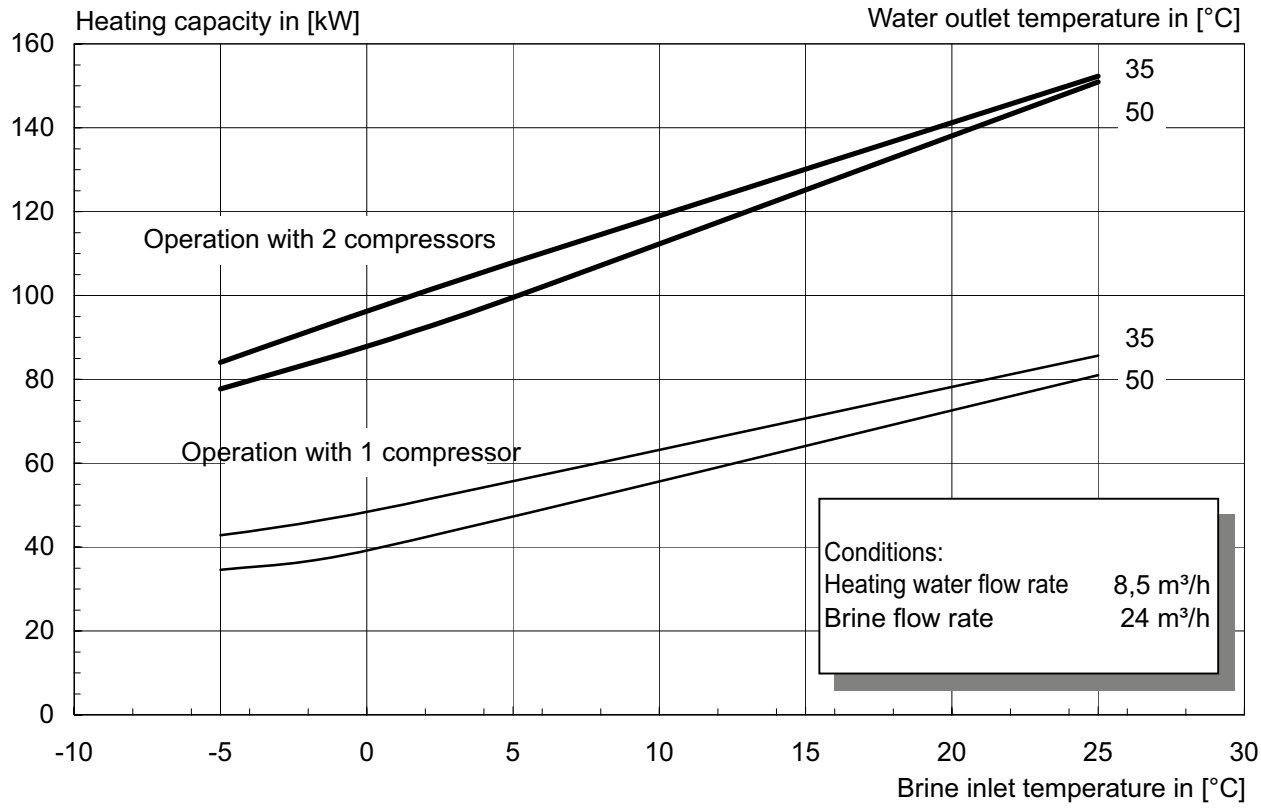


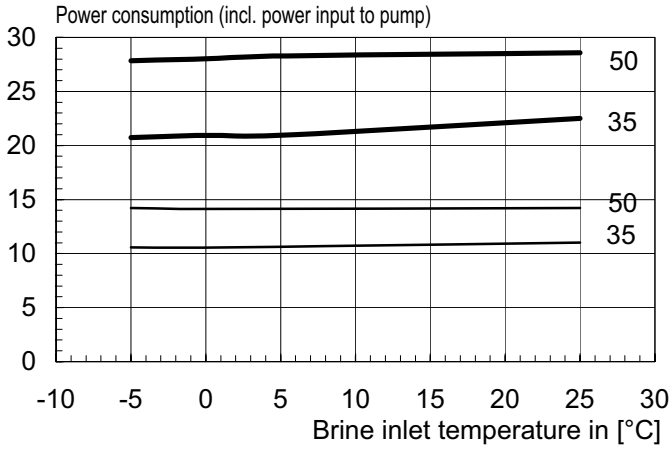


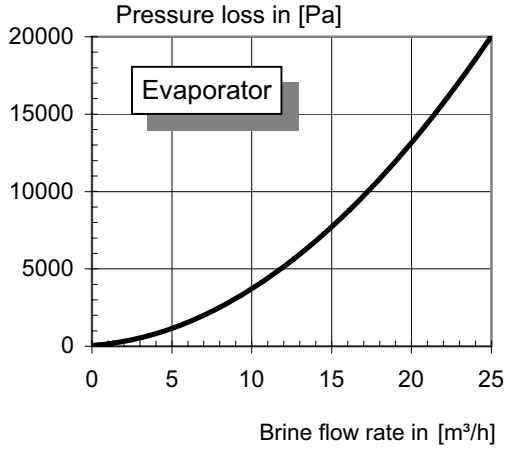


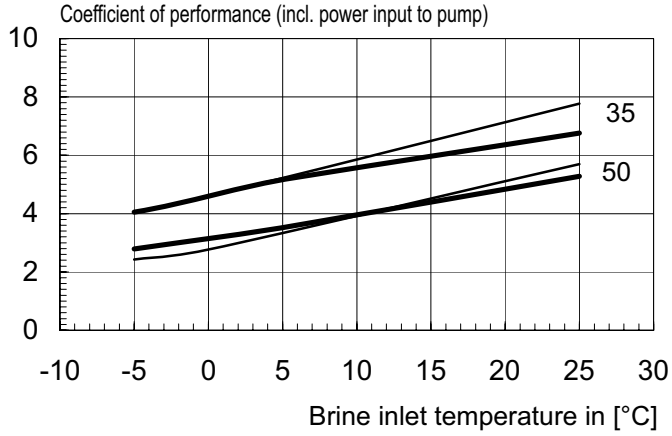


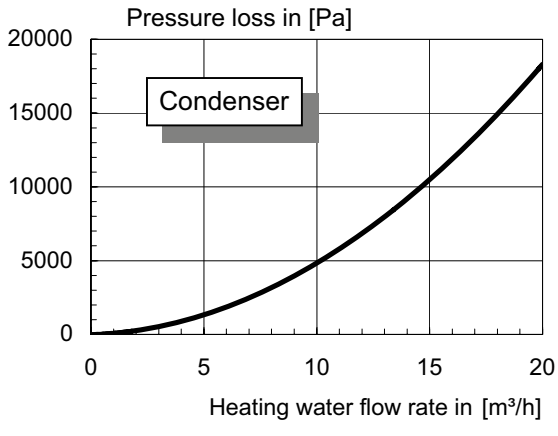
3.8.16 Characteristic curves SI 100TE



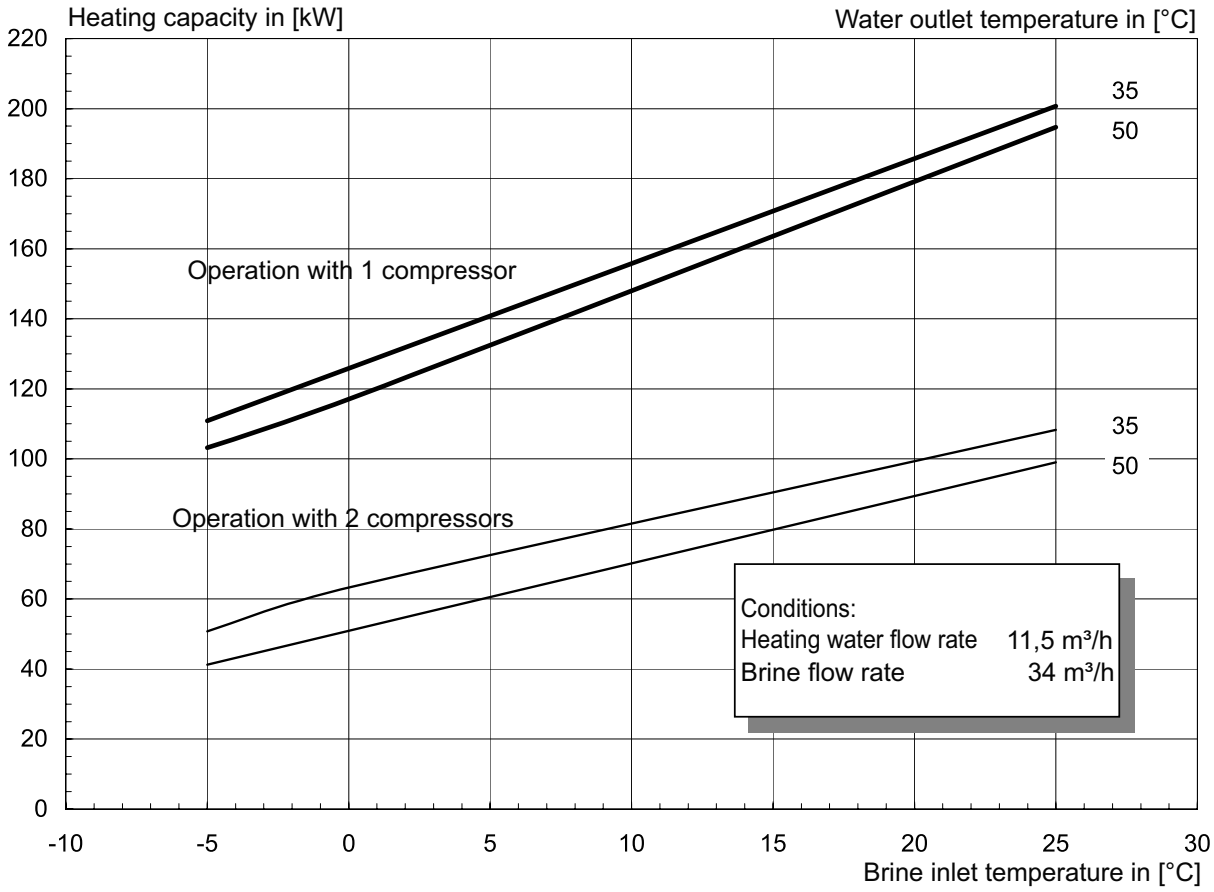


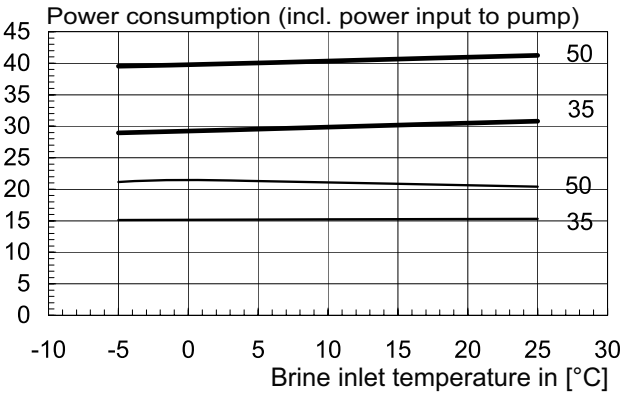


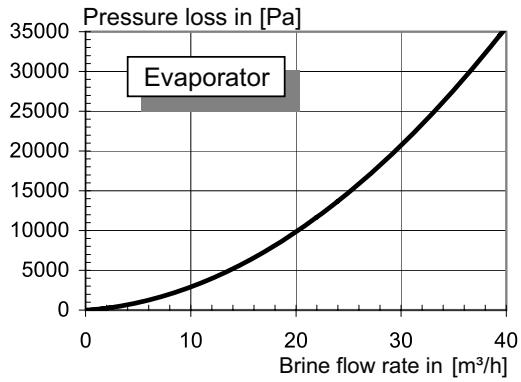


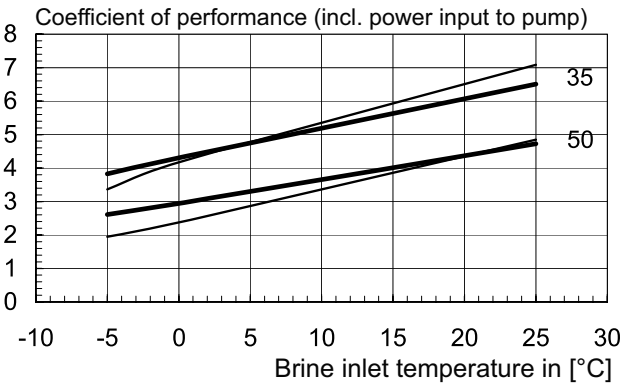


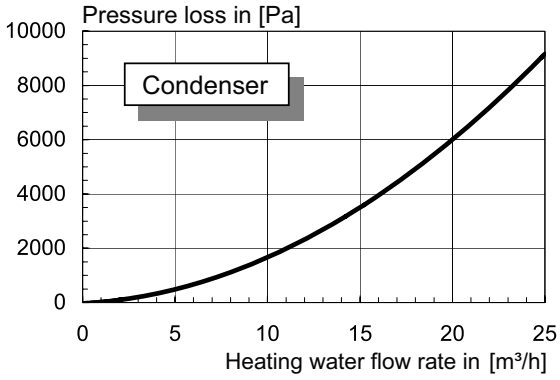
3.8.17 Characteristic curves SI 130TE



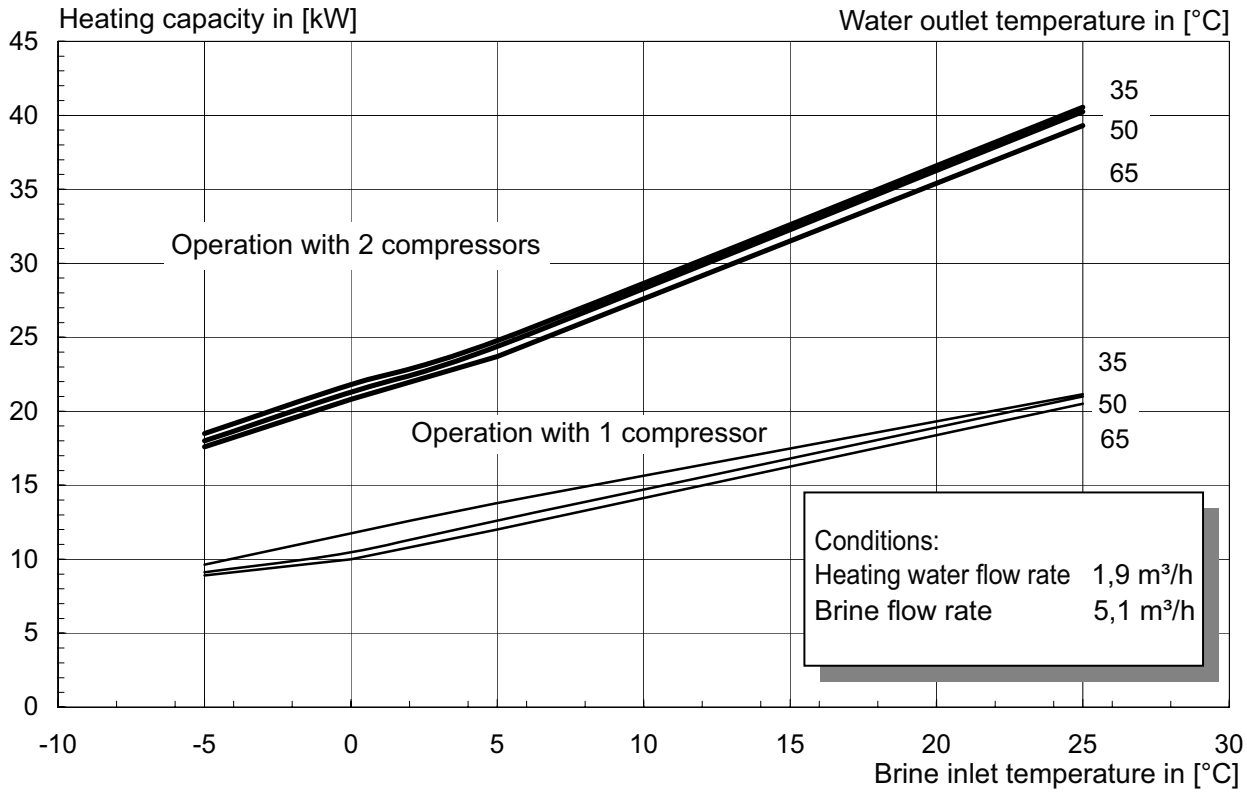


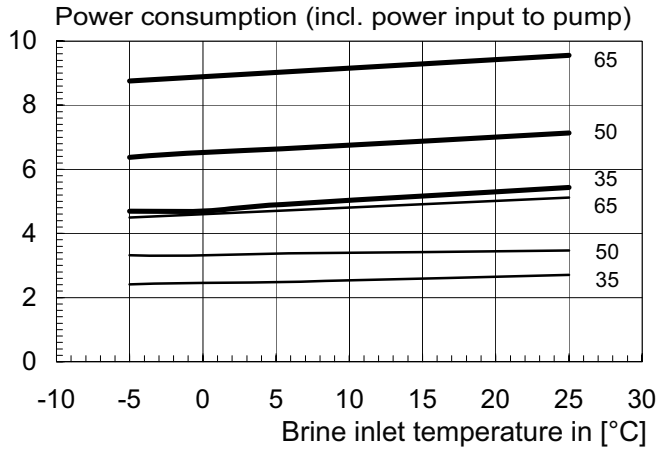


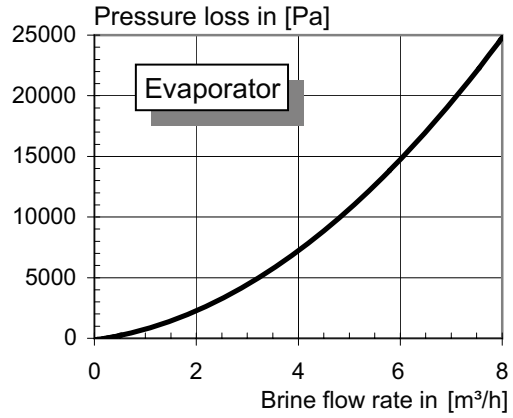


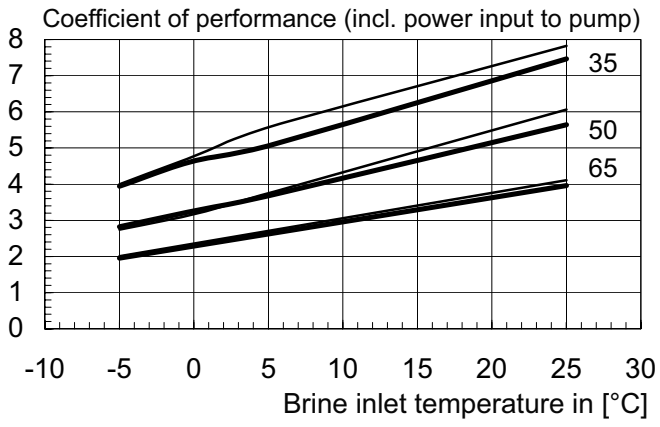


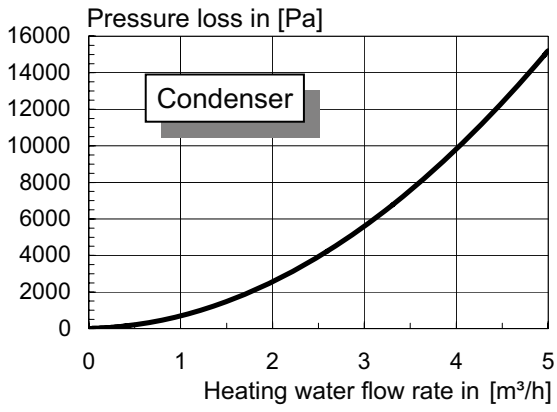
3.8.18 Characteristic curves SIH 20TE



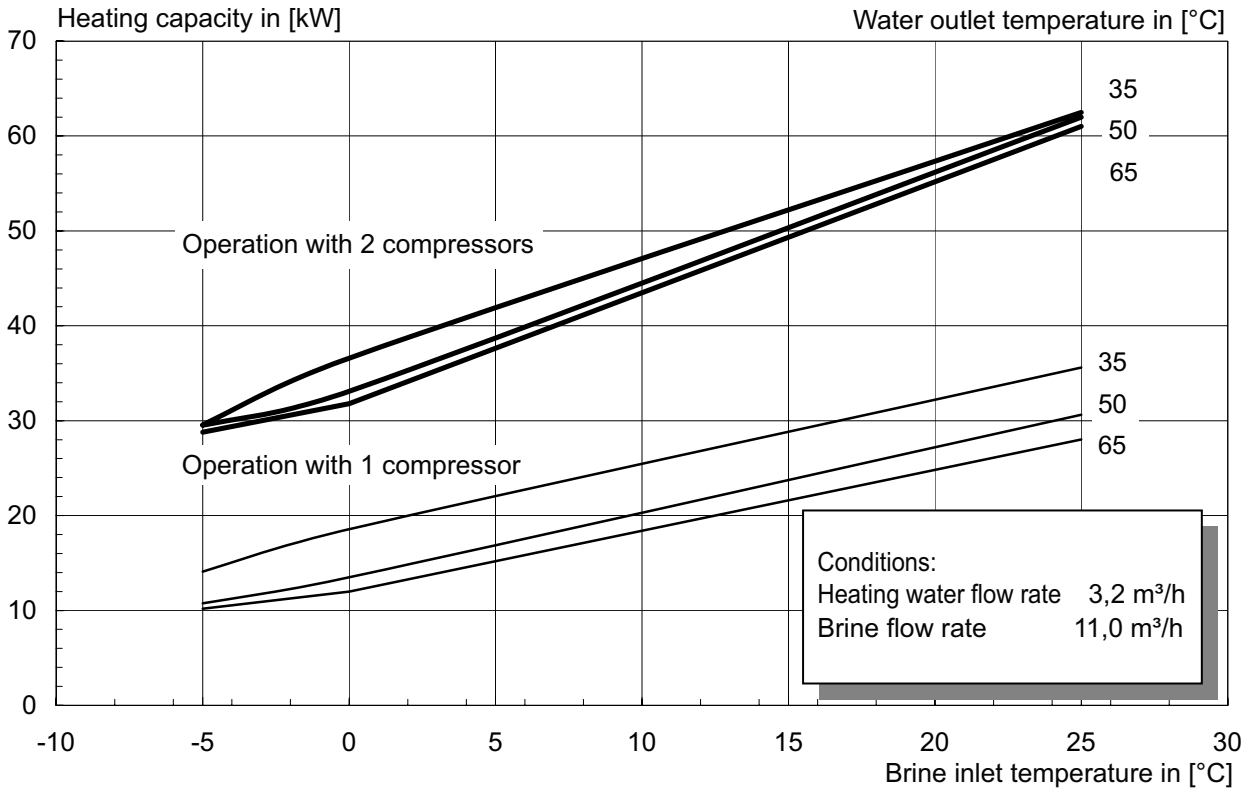


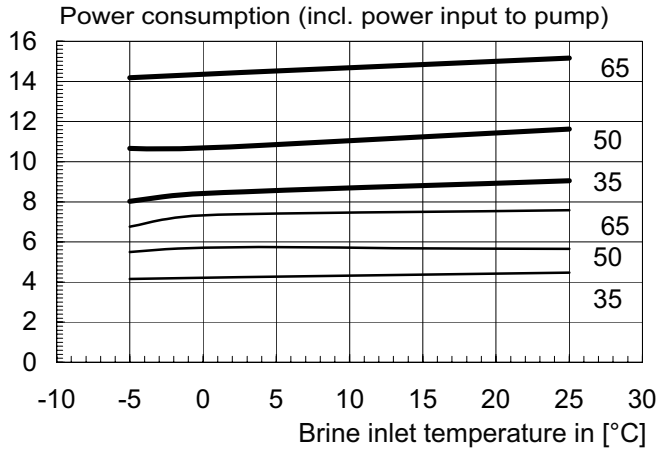


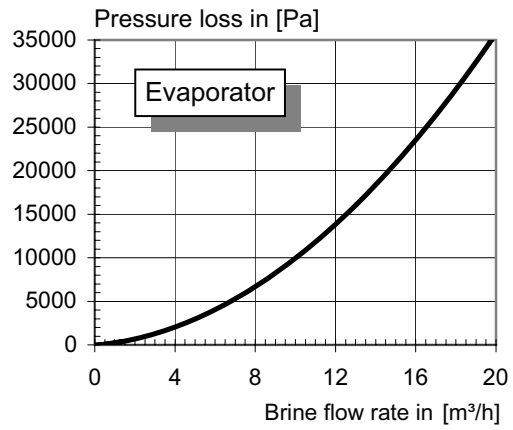


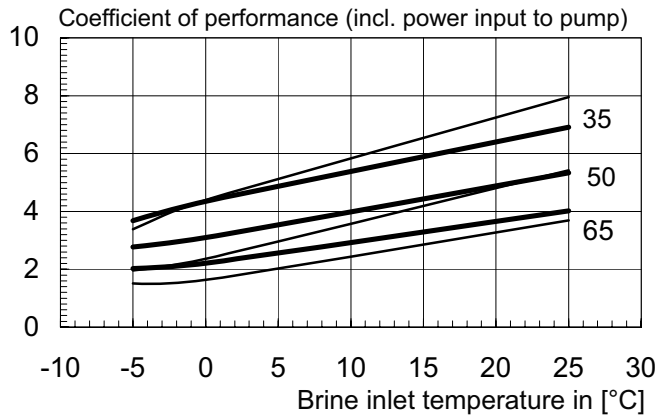


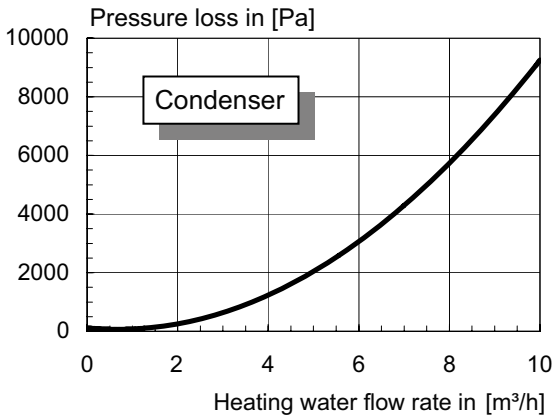
3.8.19 Characteristic curves SIH 40TE





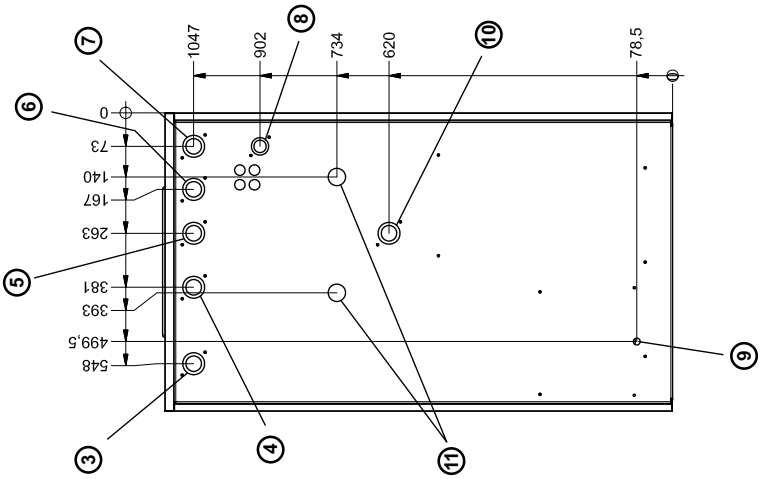




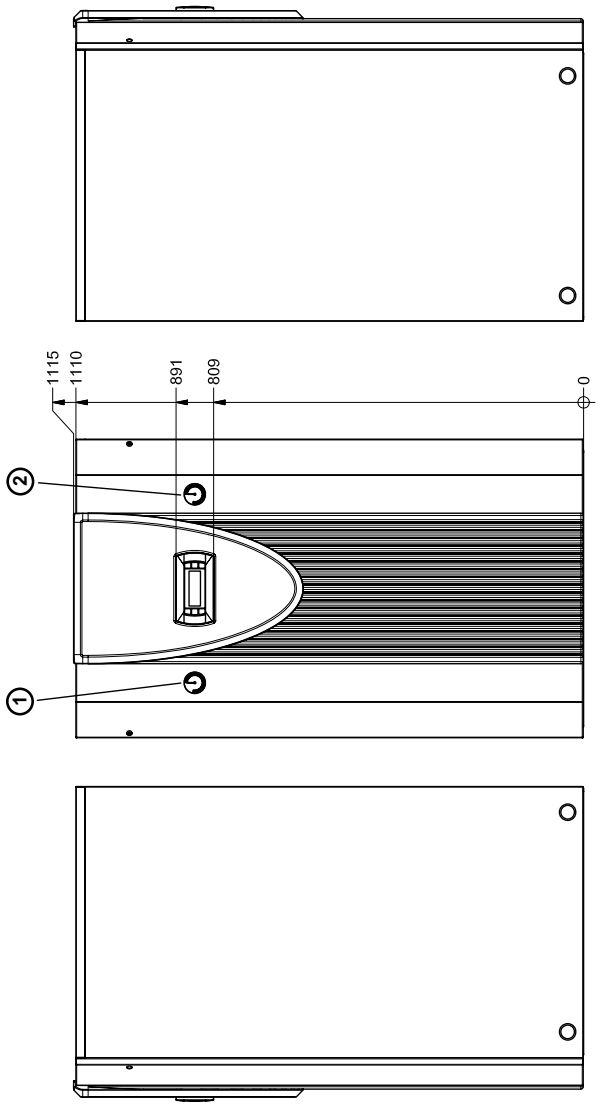


3.9 Dimensions of Brine-to-Water Heat Pumps

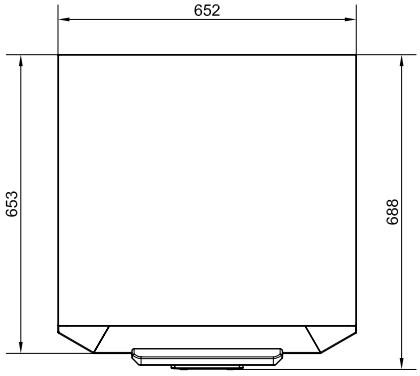
3.9.1 Dimensions SIK 11ME, SIK 16ME, SIK 7TE, SIK 9TE, SIK 11TE, SIK 14TE



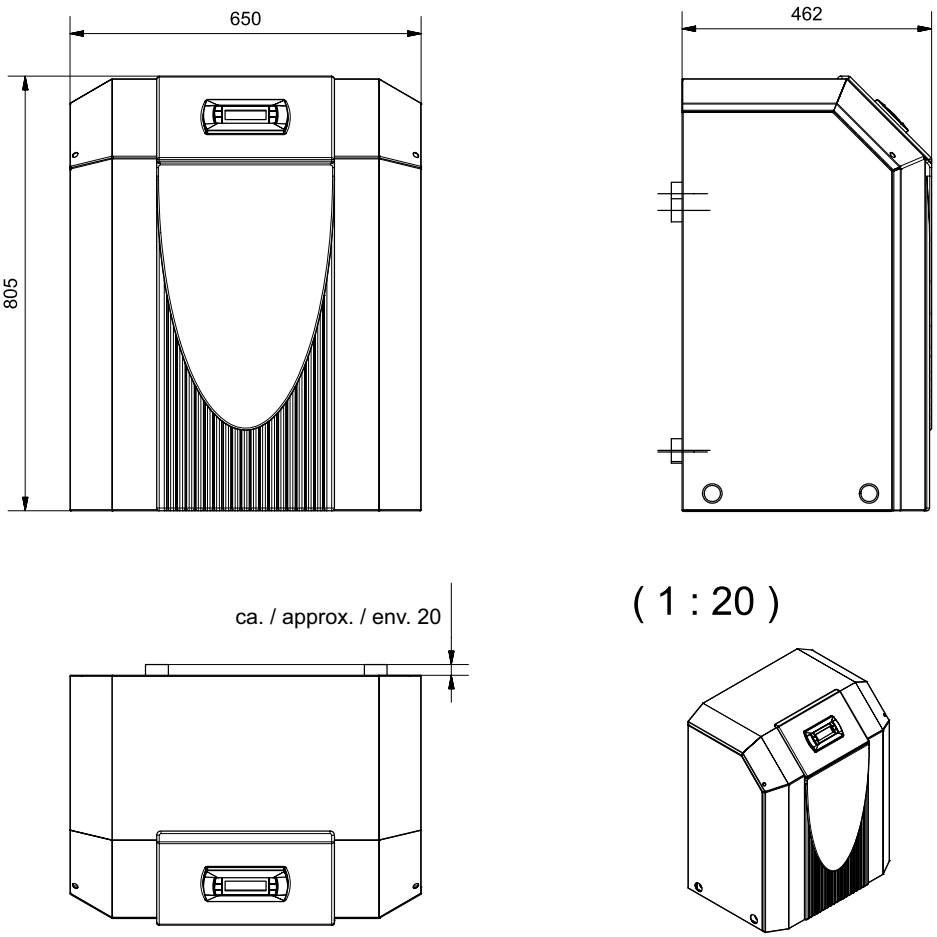
⑦	gemeinsamer Rücklauf Eingang in WP 1 1/4" Außengewinde	Common return flow Heat pump inlet 1 1/4" external thread	Retour commun Entrée dans la PAC Filetage extérieur 1 1/4"
⑧	Anschluss zusätzliches Ausdehnungsgefäß 3/4" Außengewinde	Connection of an additional expansion vessel 3/4" external thread	Raccord pour vase d'expansion supplémentaire Filetage extérieur 3/4"
⑨	Kondensatablauf Außendurchmesser 12mm	Condensate outflow 12mm outer diameter	Ecoulement du condensat Diamètre extérieur 12mm
⑩	Warmwasservorlauf Ausgang aus WP 1 1/4" Außengewinde	Hot water flow Heat pump outlet 1 1/4" external thread	Aller eau chaude Sortie de la PAC Filetage extérieur 1 1/4"
⑪	Auslauf Überdruck Sole- und Heizkreis 3/4" Schlauch	Overpressure outlet Brine and heating circuits 3/4" hose	Décharge surpression Circuits eau glycolée et chauffage Tuyau flexible 3/4"

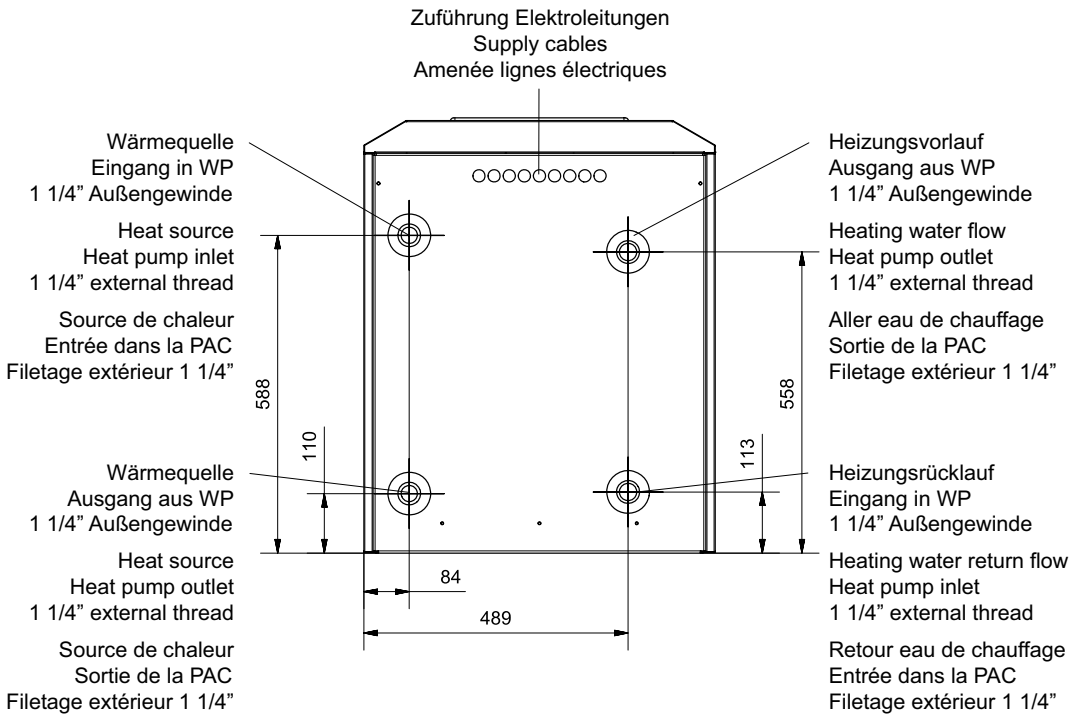


①	Manometer Heizkreis	Heating circuit pressure gauge	Manomètre circuit de chauffage
②	Manometer Solekreis	Brine circuit pressure gauge	Manomètre circuit eau glycolée
③	Wärmequelle Eingang in WP 1 1/4" Außengewinde	Heat source Heat pump inlet 1 1/4" external thread	Source de chaleur Entrée dans la PAC Filetage extérieur 1 1/4"
④	Wärmequelle Ausgang aus WP 1 /14" Außengewinde	Heat source Heat pump outlet 1 /14" external thread	Source de chaleur Sortie de la PAC Filetage extérieur 1 1/4"
⑤	Heizungsvorlauf Ausgang aus WP 1 1/4" Außengewinde	Heating water flow Heat pump outlet 1 1/4" external thread	Aller eau de chauffage Sortie de la PAC Filetage extérieur 1 1/4"
⑥	Überströmventil 1 1/4" Außengewinde	Overflow valve 1 1/4" external thread	Soupape de trop-plein Filetage extérieur 1 1/4"

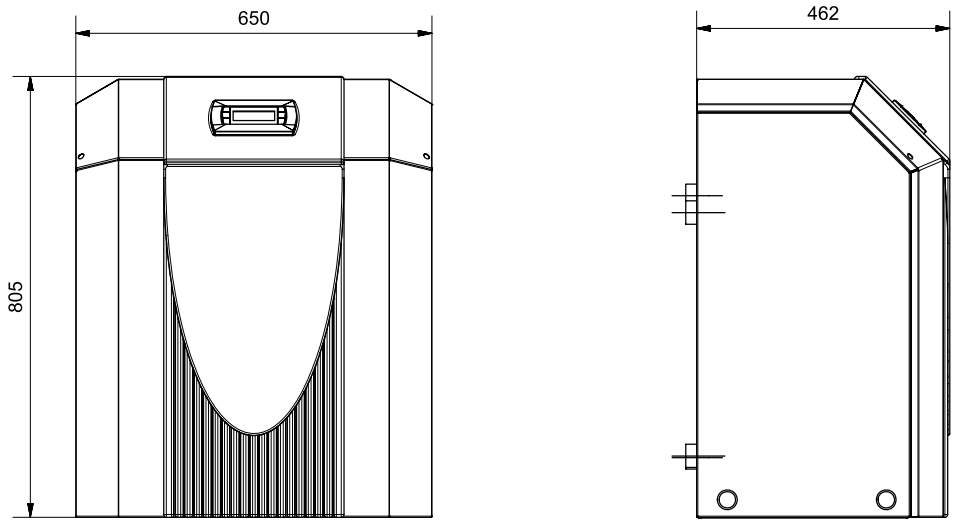


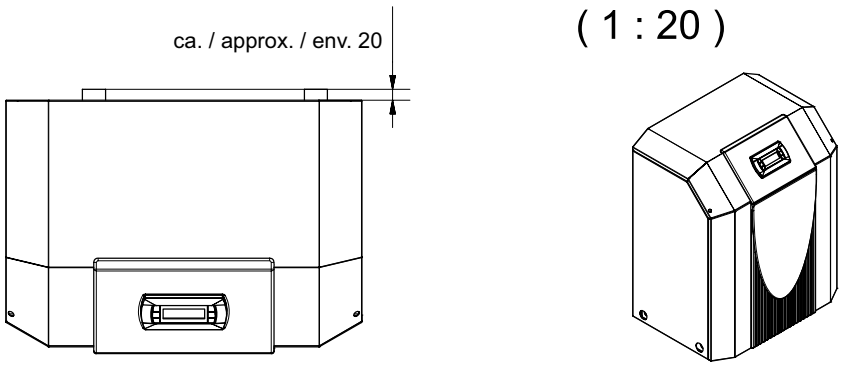
3.9.2 Dimensions SI 5ME, SI 7ME, SI 9ME, SI 11ME, SI 14ME

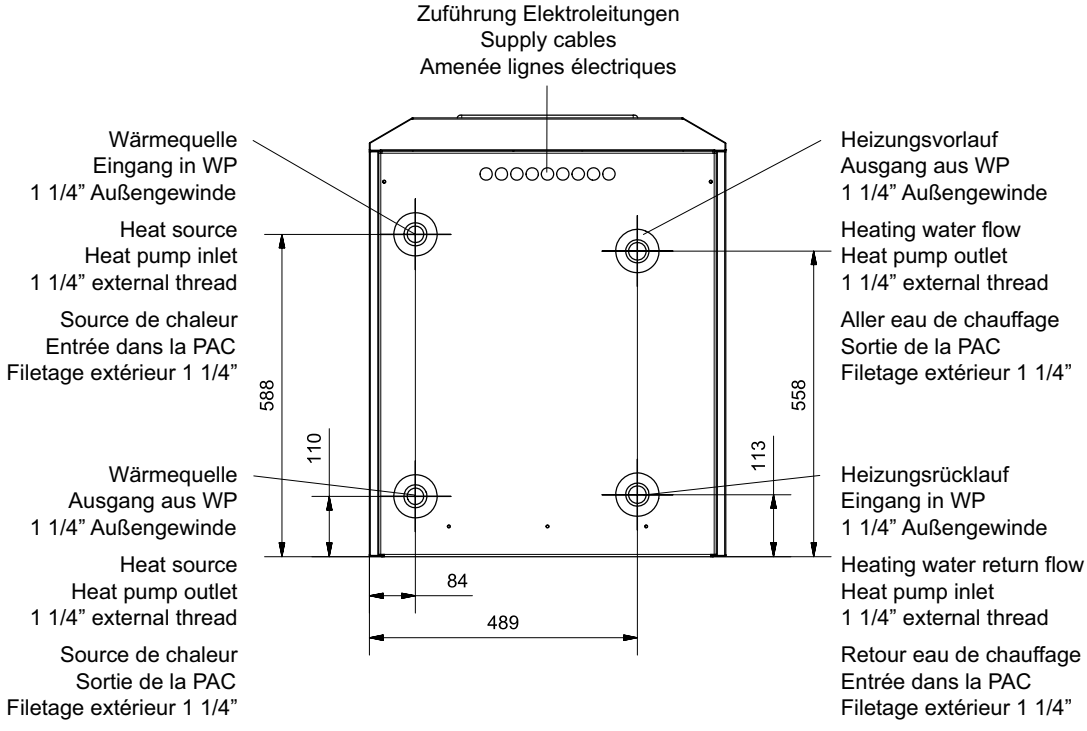




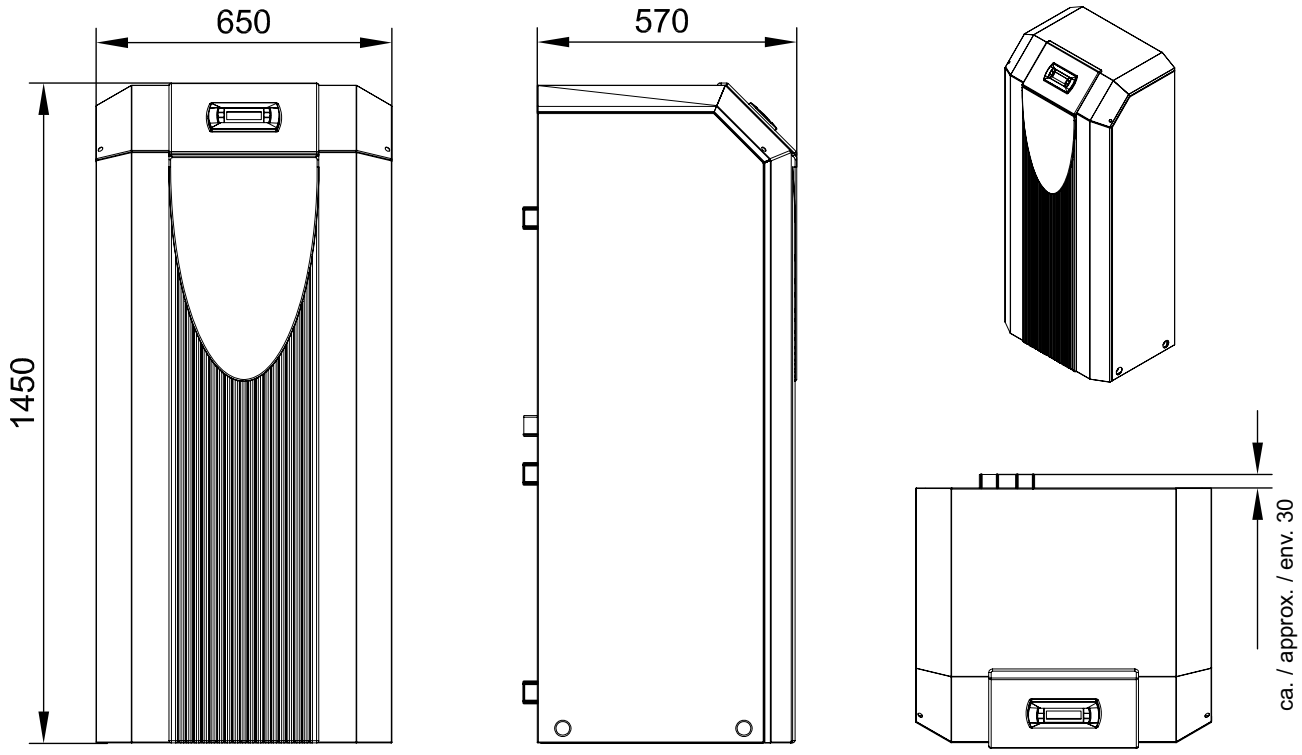
3.9.3 Dimensions SI 5TE, SI 7TE, SI 9TE, SI 11TE, SI 14TE, SI 17TE

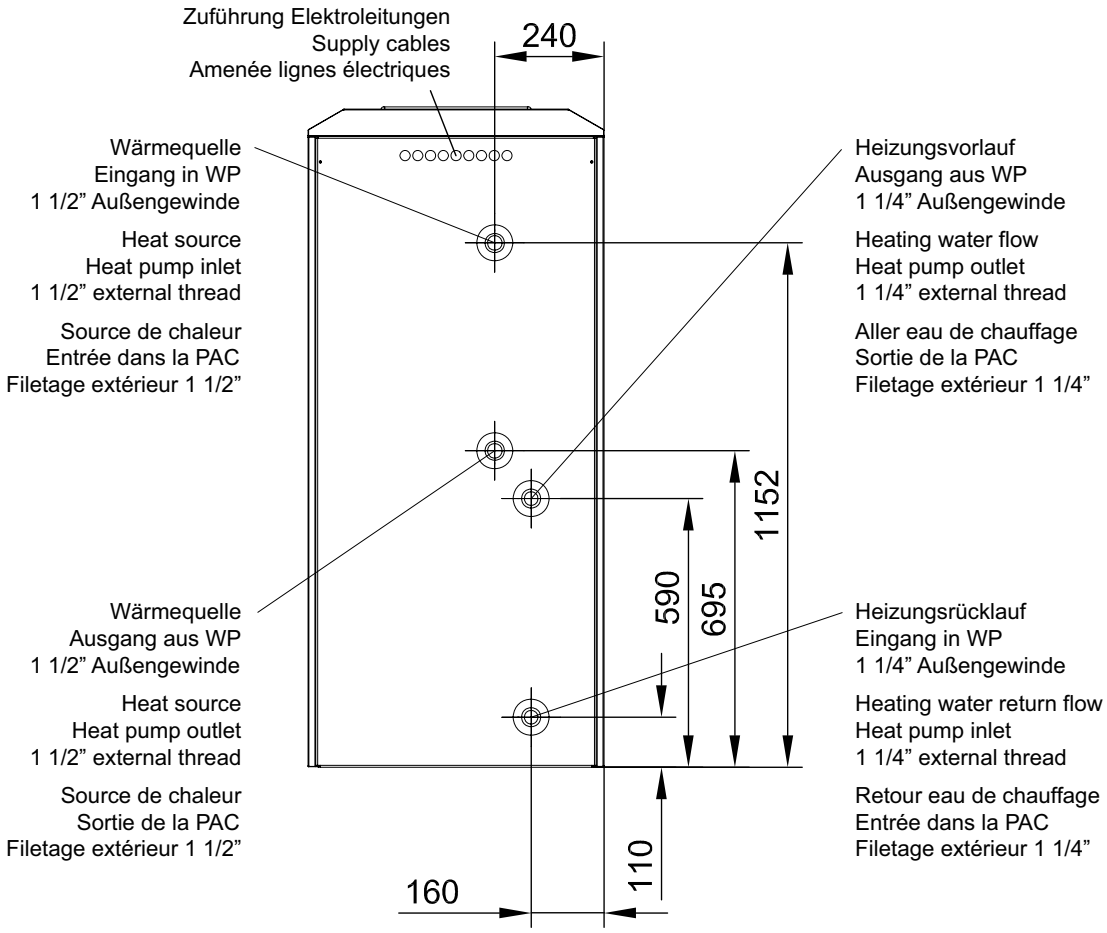




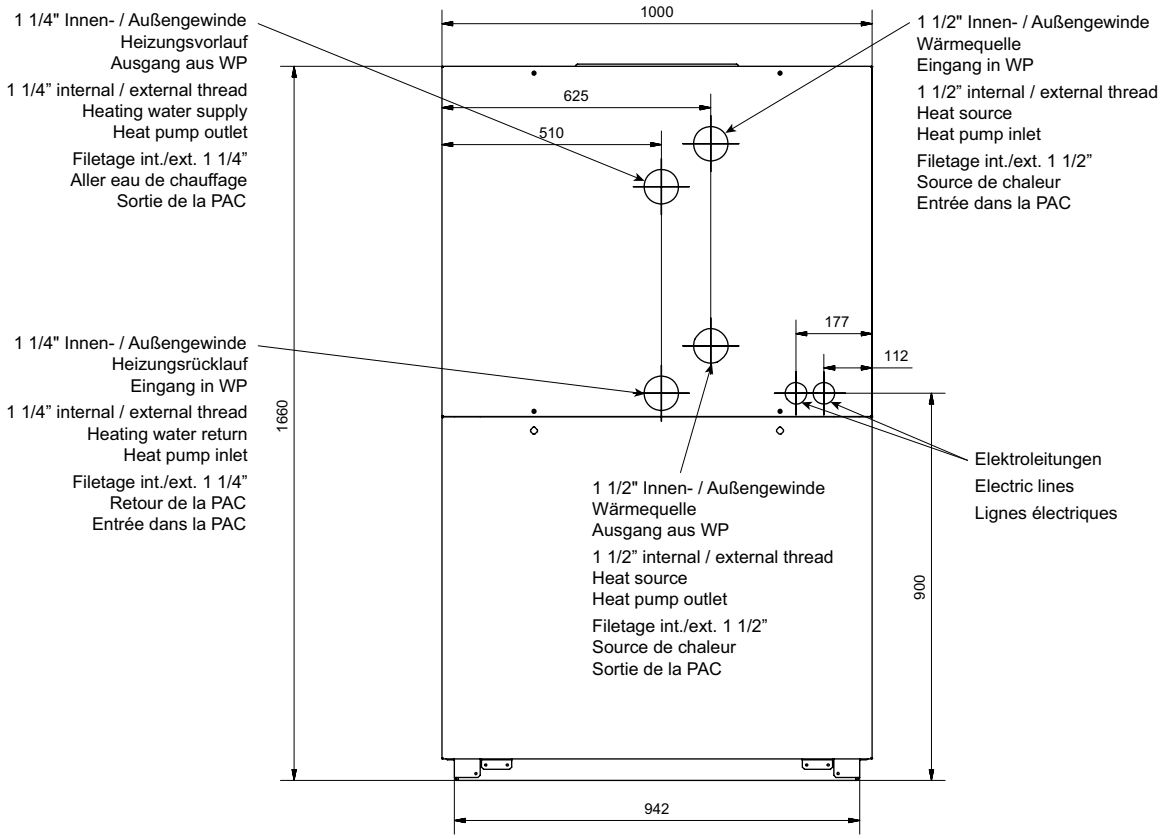


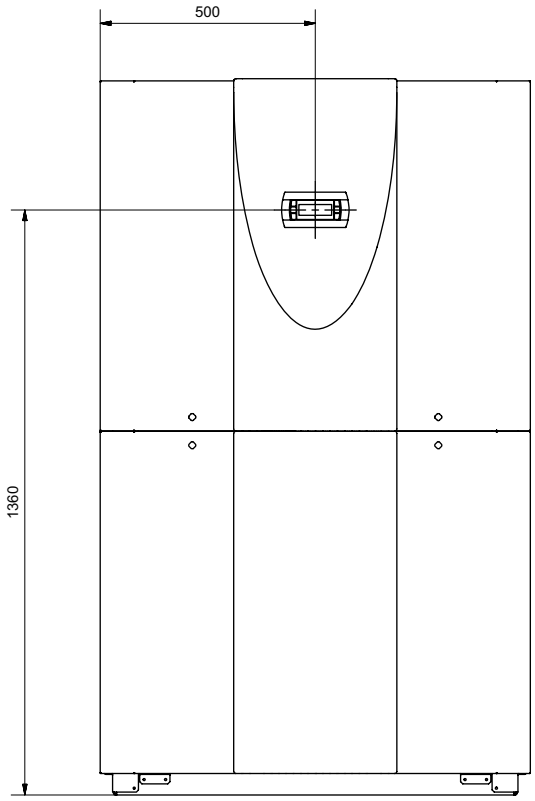
3.9.4 Dimensions SI 21TE

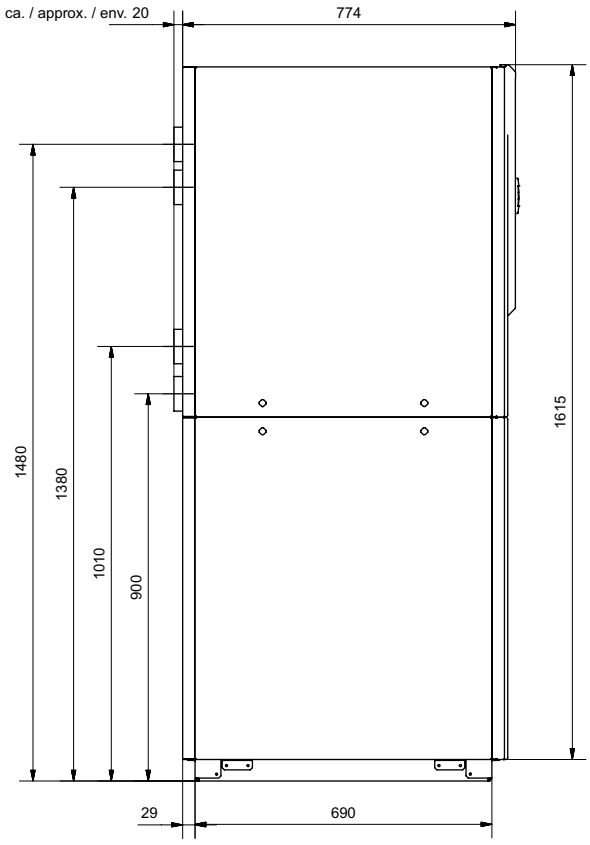




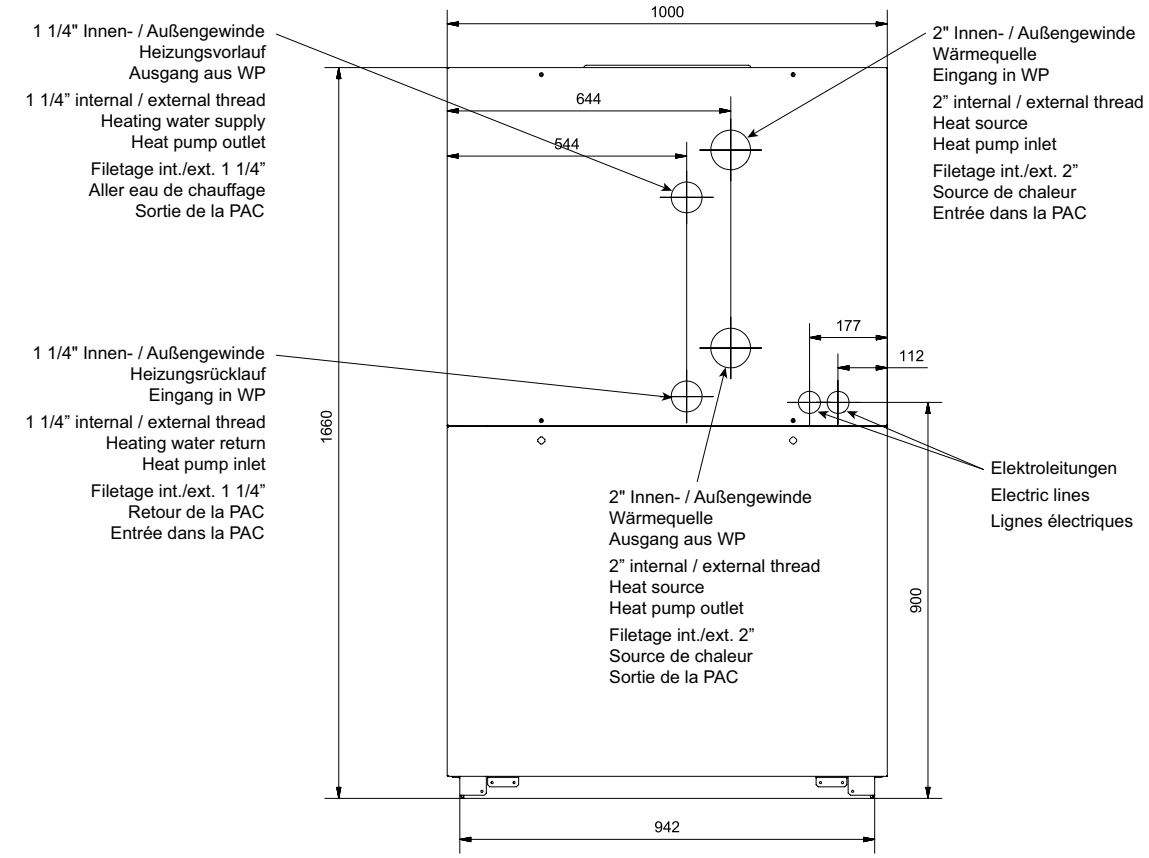
3.9.5 Dimensions SI 24TE

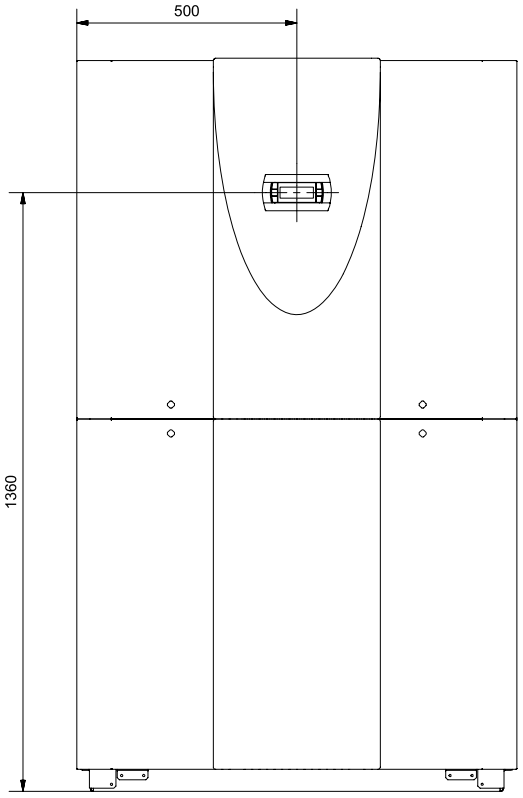


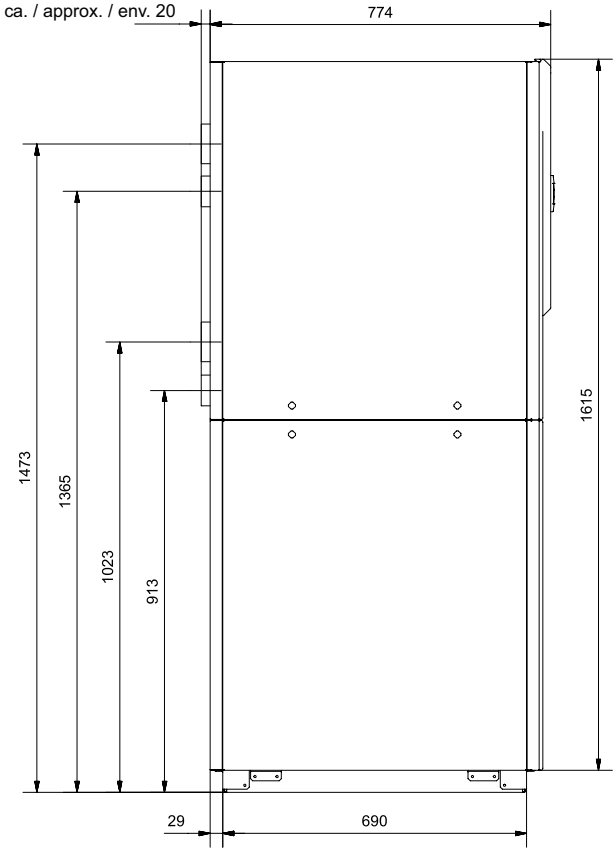




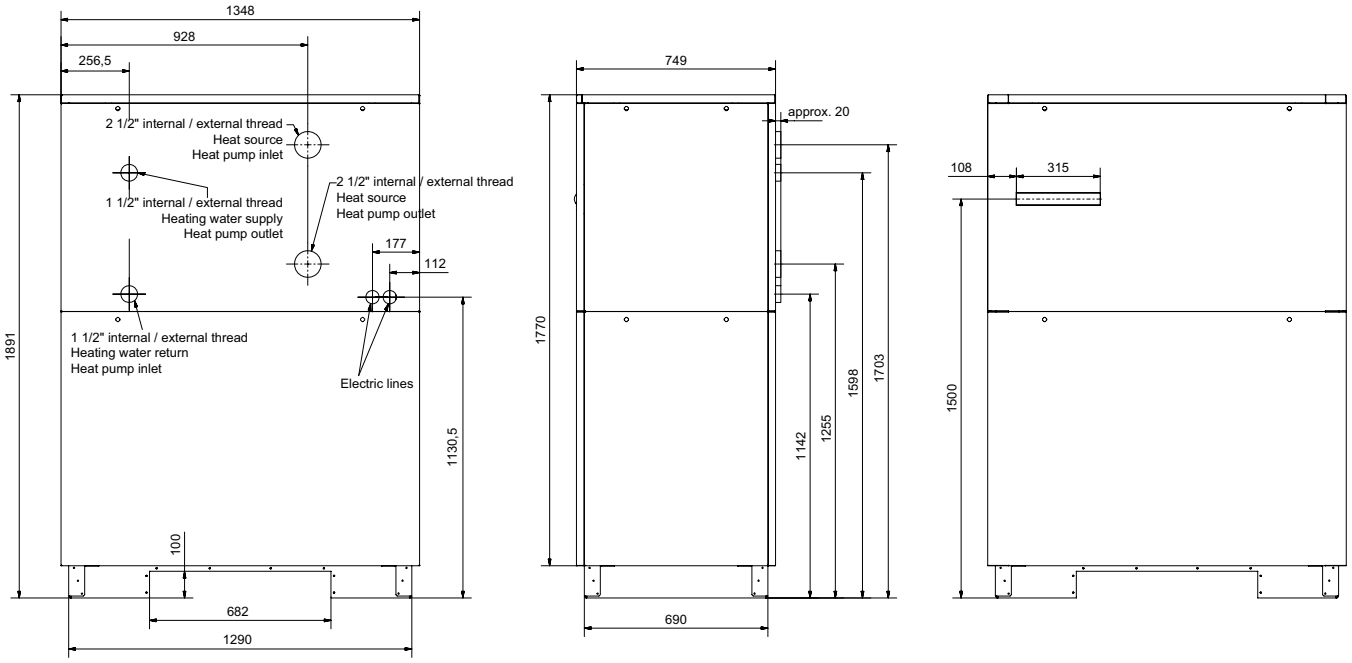
3.9.6 Dimensions SI 37TE



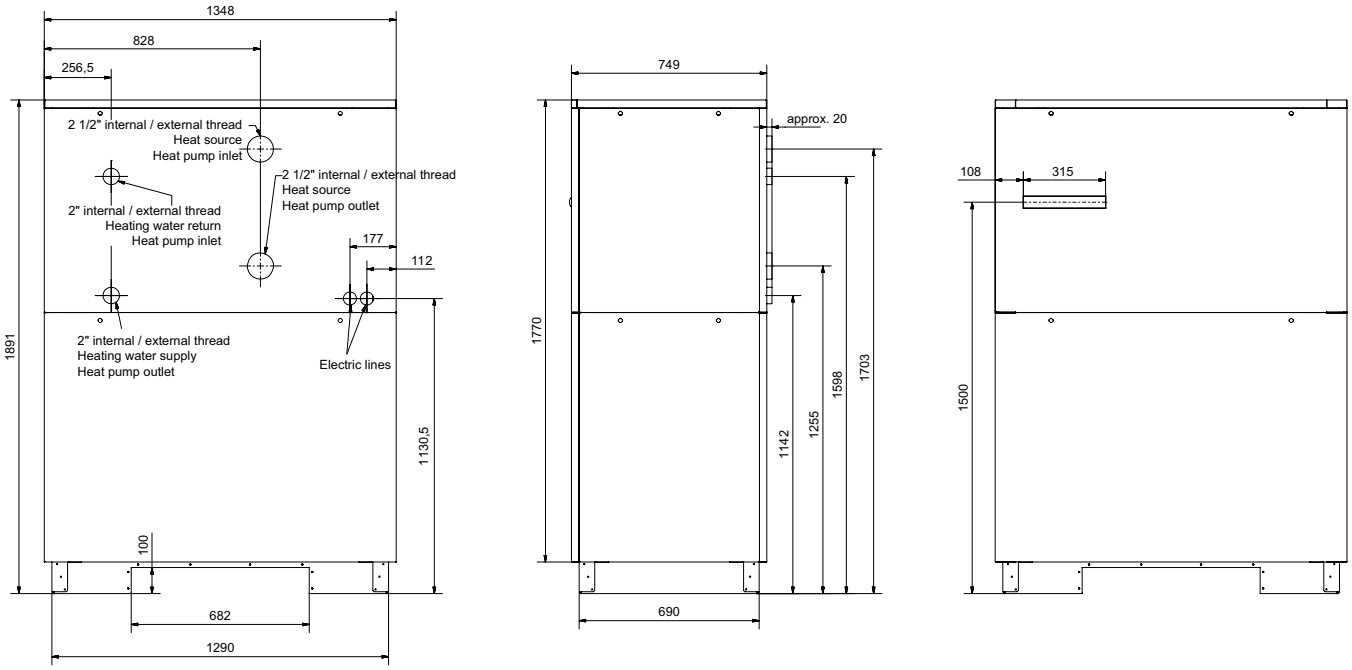




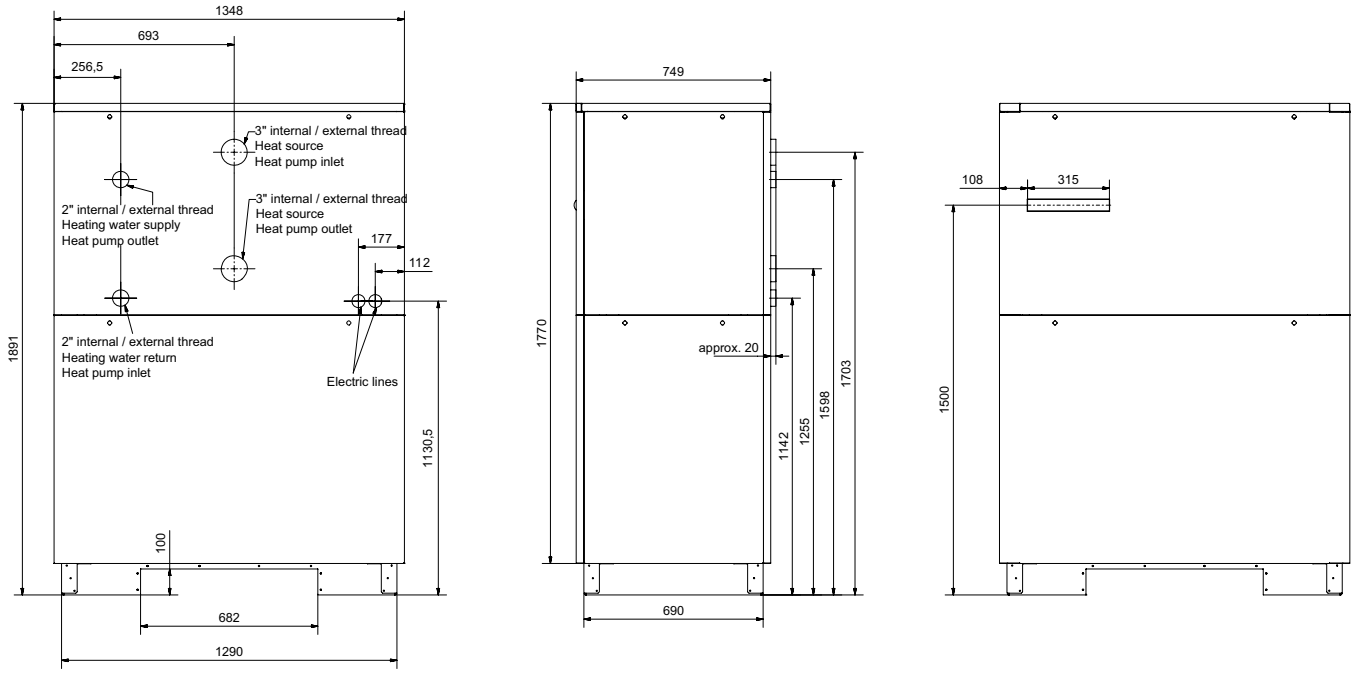
3.9.7 Dimensions SI 50TE



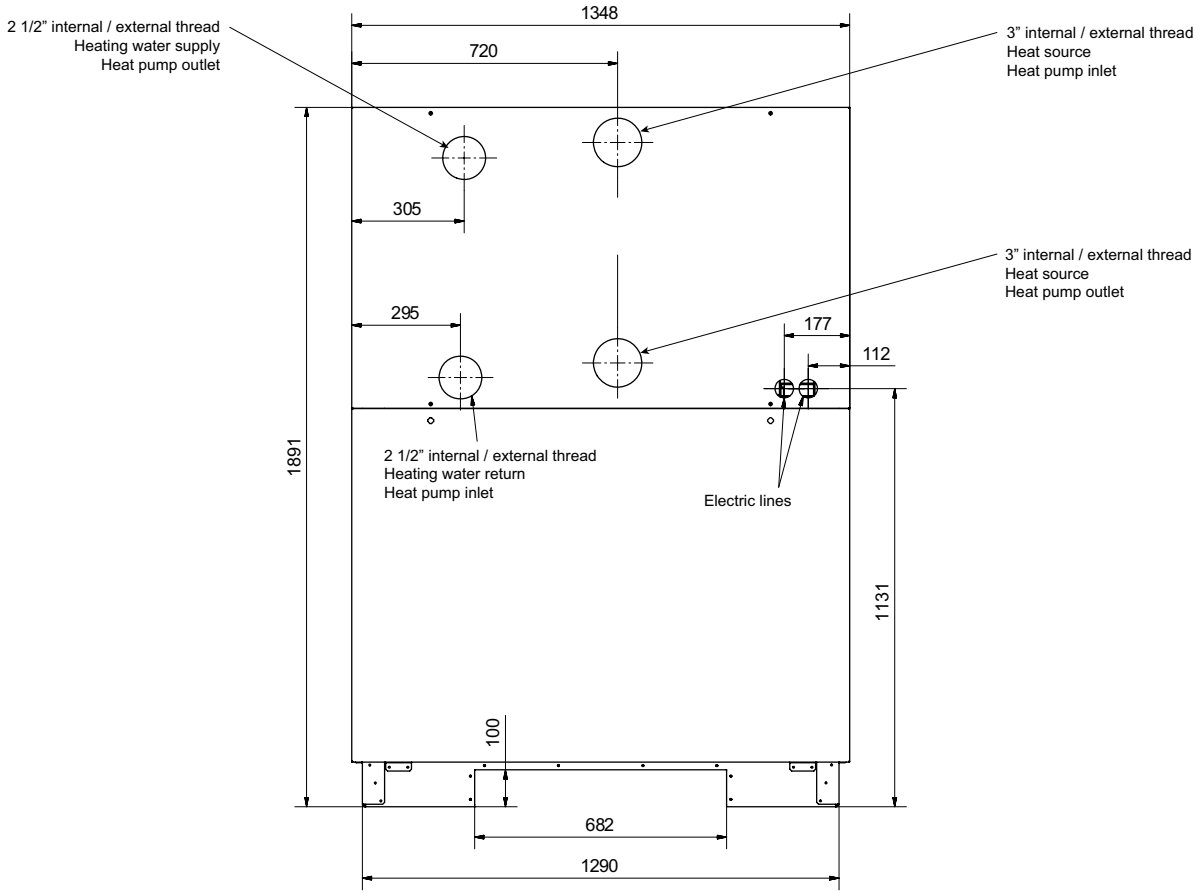
3.9.8 Dimensions SI 75TE

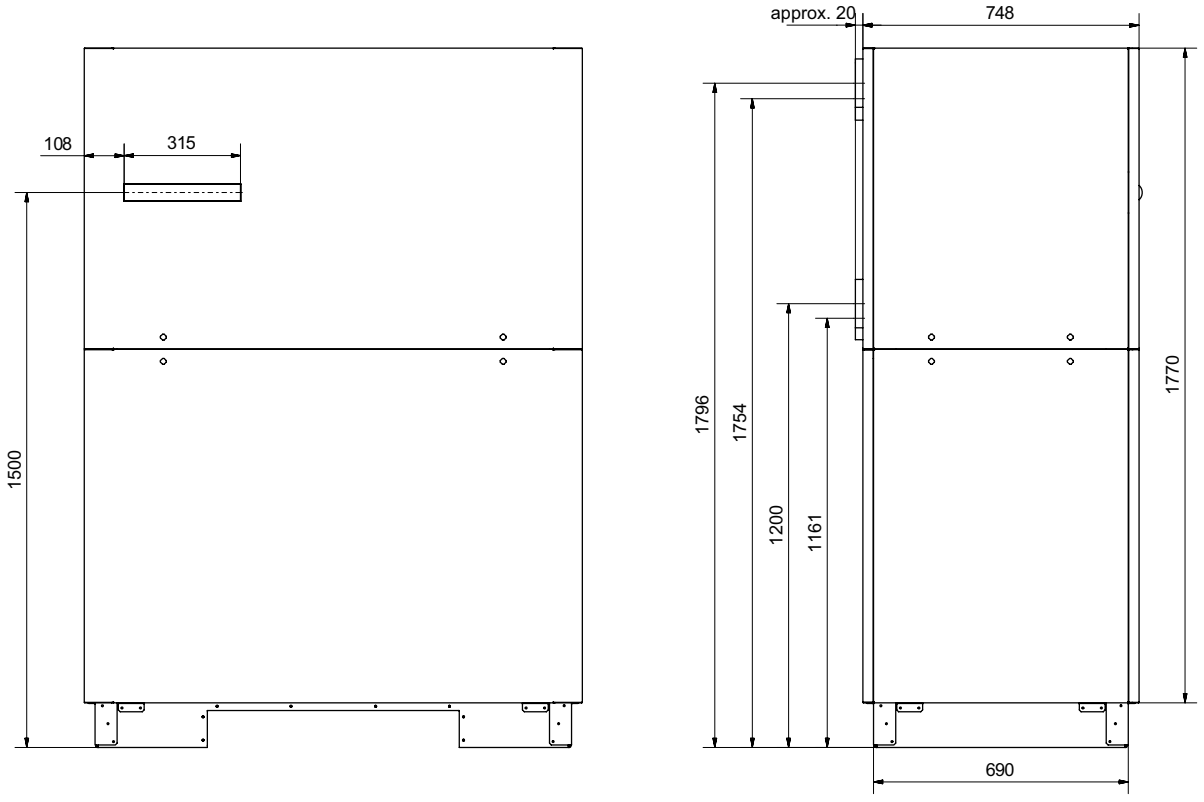


3.9.9 Dimensions SI 100TE

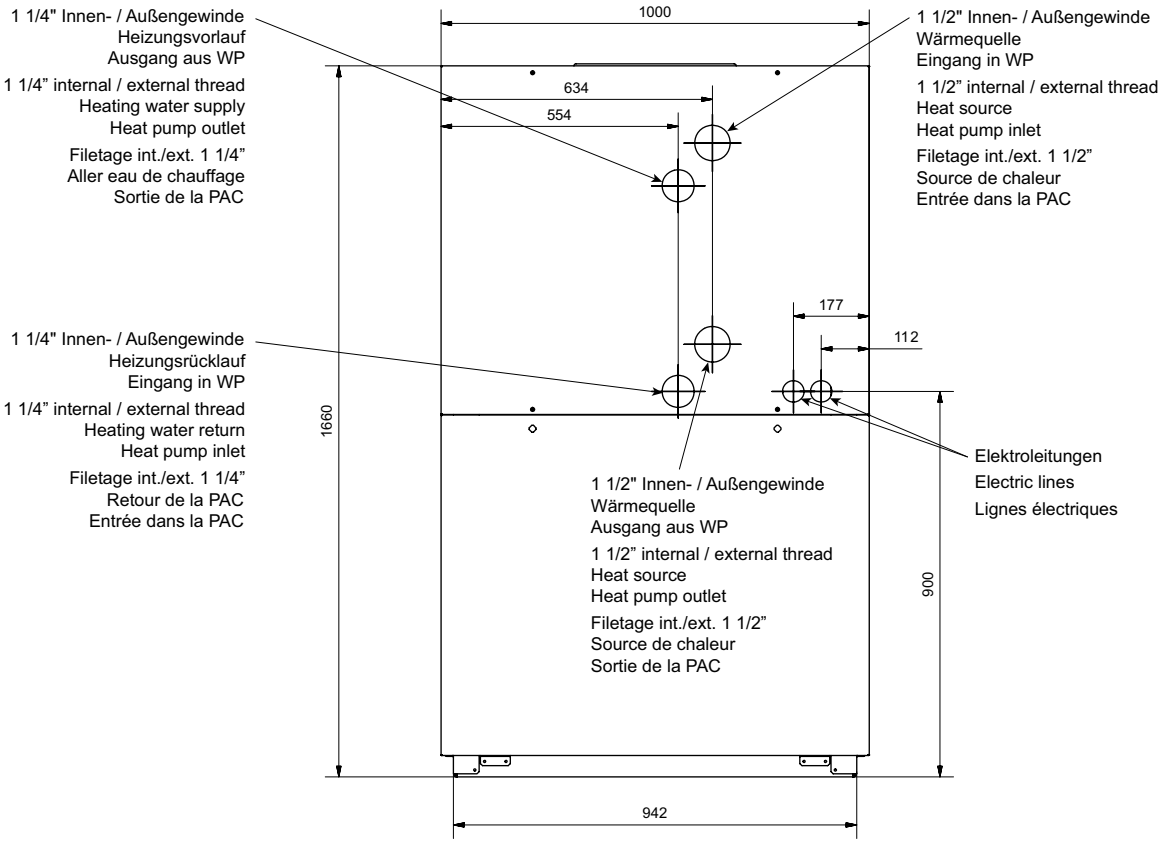


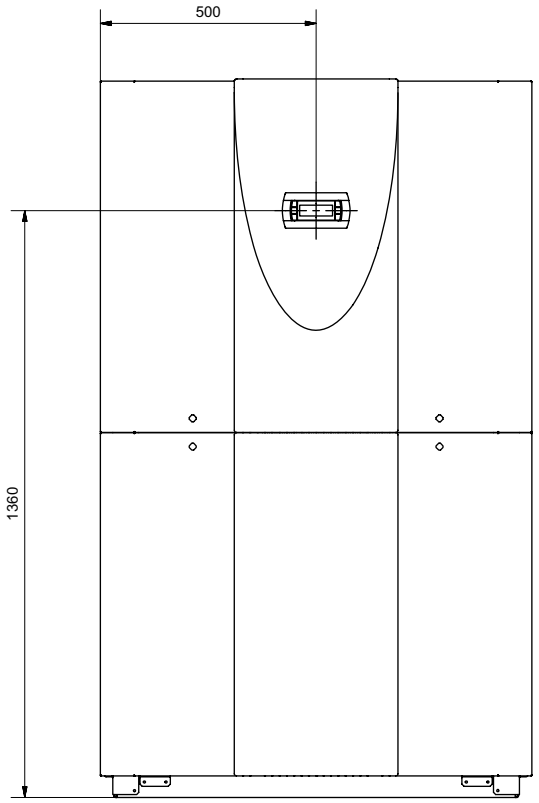
3.9.10 Dimensions SI 130TE

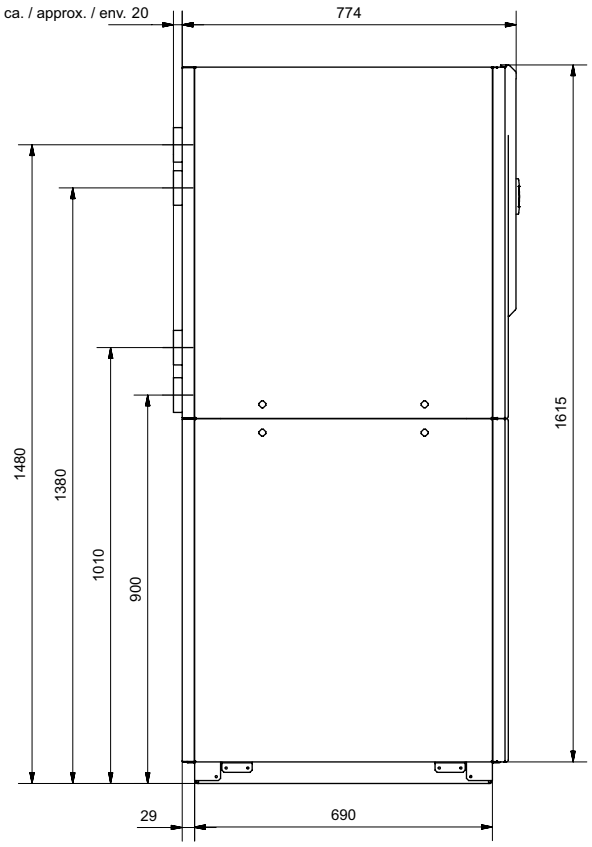




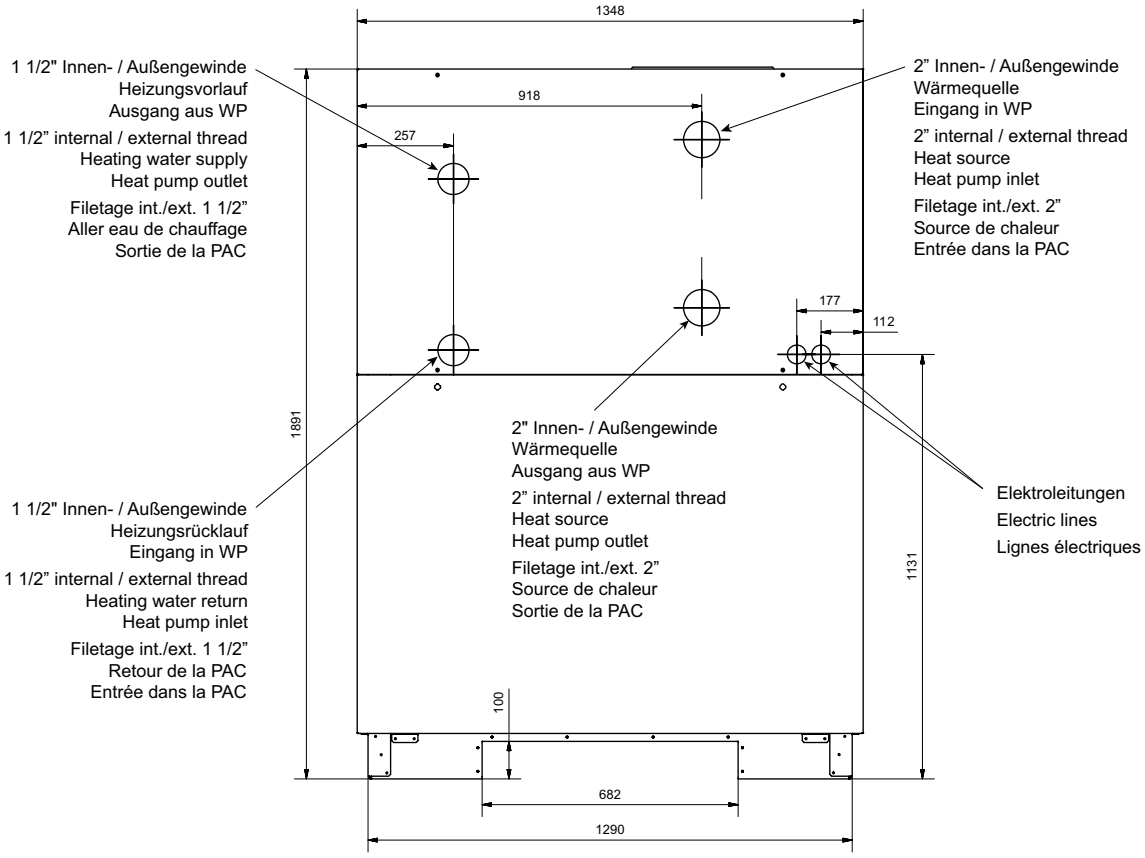
3.9.11 Dimensions SIH 20TE

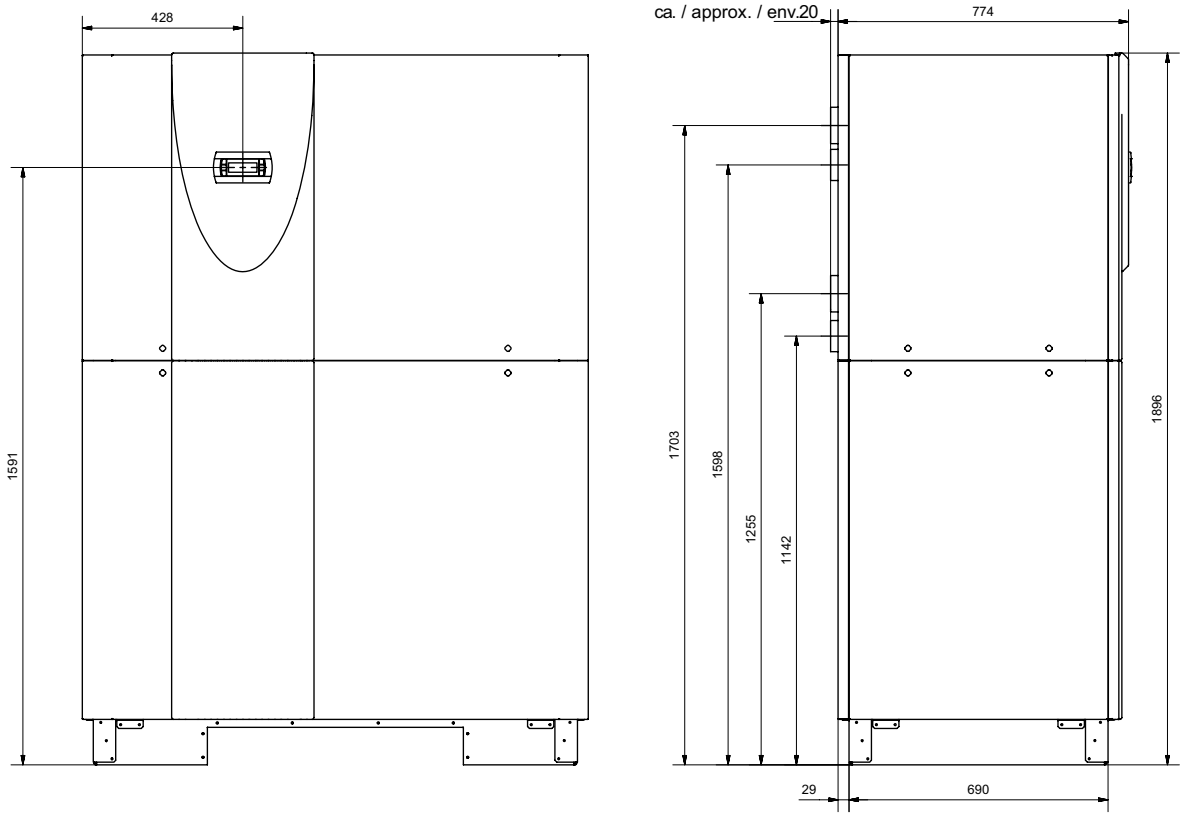






3.9.12 Dimensions SIH 40TE





4 Water-to-Water Heat Pump

4.1 Ground Water as Heat Source

Temperature range of the ground water 7 to 12 ° C

Operating range of the water-to-water heat pump 7 to 25 °C

Availability

- Year round

Types of operation

- Monovalent
- Mono energy
- Bivalent mode (alternative, parallel)
- Bivalent-renewable mode

Development costs

- Approval process (local water authority)
- Extraction wells / absorption wells with air-tight sealing of the wellheads
- Water quality (water analysis)
- Pipework
- Well pump
- Excavation/construction work

Tapping the ground water heat source

Starting at a well depth of between 8 to 10m, the ground water heat source is suitable for monovalent heat pump operation, as it is only susceptible to minor temperature fluctuations throughout the year (7-12°C). Approval is required from the appropriate water authorities for heat extraction from ground water. Permission is generally given outside of water protection zones. However, permission is dependent on certain conditions, e.g. a specified maximum amount of water that may be withdrawn, or a water analysis. The amount of water that may be withdrawn depends on the heat output. *Table 4.1 on p. 127* lists the necessary withdrawal quantities for the operating point W10/W35.

A well system with extraction and absorption wells should be designed and constructed by a drilling company accredited with the seal of approval from the International Heat Pump Association or authorised according to DVGW W120. The information in the Association of German Engineers' (VDI) publication VDI4640 Parts 1 and 2 should be taken into consideration.

NOTE

Two wells are required for the withdrawal of ground water, an “extraction well” and an “absorption well”. For economic reasons, for heat pumps with a heat output of up to 30 kW, ground water should not be pumped from depths greater than approx.15 m.

Heat Pump	Well pump (recommended for standard installation set-up)	Circulating pump for use if the quality of the water is poor and an intermediate circuit with plate heat exchanger is used	Well pump compression Bar	Cold water flow of HP m^3/h	Heat output of the heat pump kW	Refrigerating capacity of the heat pump kW	Pressure drop of the evaporator Pa	Well diameter from Inch	Motor prot. A
WI 9ME	Grundfos SP 2A-6	Not required[1]	2.4 at	2	8.3	6.7	6200	4"	4
WI 9TE	Grundfos SP 2A-6	Not required[1]	2.4 at	2	8.3	6.7	6200	4"	1,4
WI 14ME	Grundfos SP 3A-6	Not required[1]	2.3 at	3.3	13.6	10.9	19000	4"	4
WI 14TE	Grundfos SP 3A-6	Not required[1]	2.3 at	3.3	13.6	11	19000	4"	1.4
WI 18TE	Grundfos SP 5A-4	Not required[1]	1.8 at	4.0	17.1	13.9	12000	4“	1.4
WI 22TE	Grundfos SP 5A-4	Not required[1]	1.6 at	5	21.5	17.6	20000	4"	1.4
WI 27TE	Grundfos SP 8A-5	Not required[1]	2.2 at	7	26.4	21.3	16000	4"	2.3
WI 40CG	Grundfos SP 8A-5	Wilo Top-S 40/7[2]	1.7 at	9.5	44	36.3	17500	4"	2.3
WI 90CG	Grundfos SP 17-2	Wilo Top-S 50/7[2]	1.1 at	20	92	75	19000	6"	3.4
WI 90CG	Grundfos SP 17-3	Wilo Top-S 50/7[2]	1.8 at	20	92	75	19000	6“	5.5[3]

1. Stainless steel coil heat exchanger as standard!
2. Control via M11 output (primary pump) on HPM
3. Standard protective motor switch must be replaced!

Table 4.1: Dimensioning table of the minimum well pump specifications required for water-to-water heat pumps at W10/W35 for standard installation set-ups with sealed wells. The final specifications of the well pump must be agreed upon in consultation with the well constructor.

NOTE

The overcurrent relays integrated in the heat pumps must be set during installation.

4.2 Water Quality Requirements

Irrespective of any legal regulations, the ground water should not contain any substances that could form deposits. Iron (<0.2 mg/l) and Manganese (<0.1mg/l) limit values must be adhered to in order to prevent iron ochre sedimentation in the heat source system.

Experience has shown that contamination with grains larger than 1mm (organic components in particular) can easily cause damage. Granular material (fine sand) does not deposit if the specified water flows are adhered to.

The dirt trap included in the scope of supply of the heat pump (mesh size 0.6mm) protects the evaporator of the heat pump; it should be installed in the heat pump inflow.

⚠ ATTENTION!

Fine, colloidal contaminants that cause the water to become turbid also tend to stick and can deposit in the evaporator, thereby impairing heat transfer. These contaminants cannot be removed cost-efficiently using a filter.

The use of surface water or water containing salt is not permissible. Your local water utility can provide you with general information regarding the possible use of ground water.

a) **Water-to-water heat pumps with welded stainless steel coil heat exchangers (to WI 27TE)**
It is not necessary to carry out a water analysis with regard to evaporator corrosion if the annual mean temperature of the ground water is below 13 °C. In this case, the limit values for iron and manganese must be adhered to (iron ochre sedimentation).
For temperatures greater than 13°C (i.e. waste heat recovery), a water analysis according to *Table 4.2 on p. 128* must be carried out and the stability of the heat pump's stainless steel evaporator should be determined. If one characteristic in the column "stainless steel" is negative "-" or two characteristics are "0", then the analysis should be considered negative.

b) **Water-to-water heat pumps with copper-soldered stainless-steel plate heat exchangers (WI 40CG / WI 90CG)**
Irrespective of any legal regulations, a water analysis according to *Table 4.2 on p. 128* must be carried out to determine the resistance for the heat pump's copper-soldered evaporator. If one characteristic in the column "copper" is negative "-" or two characteristics are "0", then the analysis should be considered negative.

i NOTE

If the necessary water quality is insufficient or if this cannot be guaranteed long-term, it is recommended that a brine-to-water heat pump equipped with an intermediate circuit is installed.

Evaluation characteristic	Concentration range (mg/l)	Copper	Stainless steel > 13 °C
Substances that can settle (organic)		0	0
Ammonia NH3	< 2 2 to 20 > 20	+ 0 –	+ + 0
Chloride	< 300 > 300	+ 0	+ 0
Electr. conductivity	< 10 µS/cm 10 to 500 µS/cm > 500 µS/cm	0 + –	0 + 0
Iron (Fe), dissolved	< 0.2 > 0.2	+ 0	+ 0
Free (aggressive) carbonic acid	<5 5 to 20 > 20	+ 0 –	+ + 0
Manganese (Mn), dissolved	< 0.1 > 0.1	+ 0	+ 0
Nitrate (NO_3), dissolved	< 100 > 100	+ 0	+ +
PH value	< 7.5 7.5 to 9 > 9	0 + 0	0 + +
Oxygen	< 2 > 2	+ 0	+ +
Hydrogen sulphide (H2S)	< 0.05 > 0.05	+ –	+ 0
HCO3- / SO_4^{2-}	< 1 > 1	0 +	0 +
Hydrogen carbonate (HCO3-)	< 70 70 to 300 > 300	0 + 0	+ + 0
Aluminium (Al), dissolved	< 0.2 > 0.2	+ 0	+ +
Sulphate	Up to 70 70 to 300 >300	+ 0 –	+ + 0
Sulphite (SO3), free	< 1	+	+
Chlorine gas (Cl2)	< 1 1 to 5 > 5	+ 0 –	+ + 0

Table 4.2: Resistance of copper-soldered or welded stainless-steel plate heat exchangers to substances contained in the water
"+" normally good resistance;
„0" corrosion problems can arise, particularly if several factors receive a evaluation of "0".
"-" should not be used [< smaller than, > greater than]

4.3 Tapping the Heat Source

4.3.1 Ground water as heat source

Extraction well

The ground water for the heat pump is extracted from the earth via an extraction well. The well output must guarantee continuous extraction to ensure the required minimum water flow rate of the heat pump.

Absorption well

The ground water cooled by the heat pump is returned to the ground via an absorption well. The absorption well must be drilled 10 - 15 m downstream from the extraction well in the direction of the ground water current in order to ensure that the flow is not "short-circuited". The absorption well must be able to accommodate the same amount of water as the extraction well supplies.

Because the operational reliability of the system depends on the design and construction of the wells, this work should be carried out by an experienced well constructor.

NOTE

A list of qualified well constructors is available at www.dimplex.de.

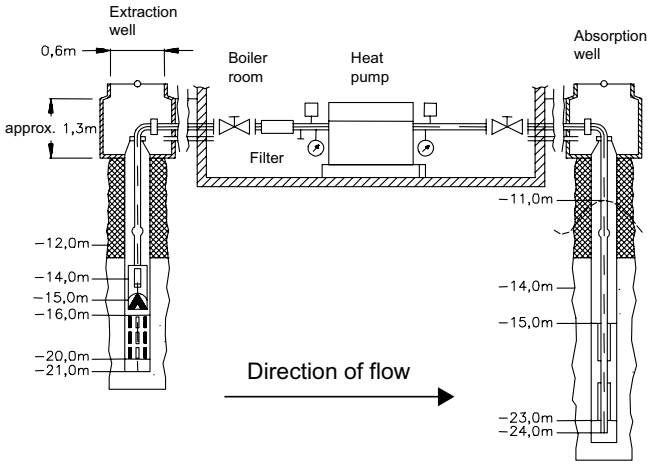


Fig. 4.1: Example of the integration of a water-to-water heat pump with extraction and absorbtion wells

4.3.2 Waste heat from cooling water as the heat source

Temperature range of the waste heat 10 to 25 °C

For utilising waste heat, you must first clarify whether the cooling water is available in suitable quality and ample amount, as well as the extent to which the heat generated by the heat pump can be used.

ATTENTION!

If the heat source temperature can rise to over 25 °C, the temperature-controlled mixer is required that, for temperatures over 25 °C, adds the cooling water to a partial volume flow of the cooling water outlet.

Cooling water of consistently good quality

The heat produced can be utilised with a water-to-water heat pump, if the compatibility of the cooling water or waste water according to*Table 4.2 on p. 128* has been verified.

If the water quality is evaluated as being too poor or if the water quality varies (i.e. in the case of a fault), a heat pump equipped with an intermediate circuit must be installed.

Cooling water with varying or poor quality

Installing an intermediate circuit helps to protect the heat pump if there is danger that the cooling water could corrode or clog the heat pump's evaporator (i.e. sedimentation).

NOTE

Generally, brine-to-water heat pumps are installed in order to expand the range of operating temperatures to lower temperatures. For water-to-water heat pumps, the system already becomes non-operational if the minimum outlet temperature of the heat pump falls below approx. 4 °C.

For brine-to-water heat pumps, the intermediate heat transfer circuit (heat exchanger - heat pump) must then be filled with an antifreeze (-14 °C) because temperatures around the freezing point could likely occur. The brine circuit should be equipped with a circulating pump and safety valves in the same way as for standard ground heat collectors and borehole heat exchangers. The circulating pump should be dimensioned in a way that ensures the intermediate heat exchanger does not freeze.

The heat exchanger is dimensioned according to the following parameters:

- Water quality
- Range of operating temperatures
- Cooling capacity of the heat pump type in use
- Primary and secondary cycle water flow

In the simplest of cases, the heat exchanger consists of PE pipes that are installed directly in the cooling water, thus requiring no additional cooling water pump. This cost-efficient alternative can be used as long as the cooling water pool is large enough.

NOTE

For the installation of a brine-to-water heat pump, the water flow in the primary cycle must be at least 10 % above the brine flow rate of the secondary cycle.

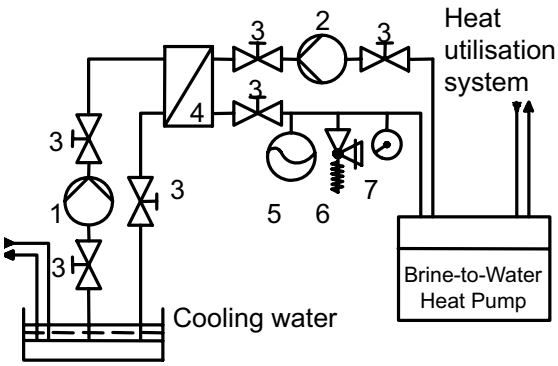


Fig. 4.2: Waste heat recovery using an intermediate heat exchanger with a brine-to-water heat pump

Legend

1) Cooling water pump
2) Heat source pump
3) Manual valve
4) Heat exchanger
5) Expansion vessel
6) Pressure relief valve
7) Pressure gauge

4.4 Device Information for Water-to-Water Heat Pumps (1-phase, 230 V AC)

4.5 Low-Temperature Heat Pumps WI 9ME to WI 14ME

Device information for water-to-water heat pumps (heating only)							
1	**Type and order code**			WI 9ME		WI 14ME	
2	**Design**						
2.1	**Degree of protection according to EN 60 529**			IP20		IP20	
2.2	**Installation Location**			Indoors		Indoors	
3	**Performance data**			EN 255	EN14511	EN 255	EN14511
3.1	**Operating temperature limits:**						
	Heating water flow		**°C**	Up to 55		Up to 55	
	Cold water (heat source)		**° C**	+7 to +25		+7 to +25	
3.2	**Temperature spread of heating water at W10 / W35K**			9.5	5.0	8.8	5.0
3.3	**Heat output / COP**	**at W7 / W55** [1]	**kW / ---**	6.9 / 2.5		12,2 / 2,3	
		at W10 / W50 [1]	**kW / ---**	7.7 / 3.2		13,4 / 3,4	
		at W10 / W45 [1]	**kW / ---**		7.7 / 3.7		13.4 / 3.8
		at W10 / W35 [1]	**kW / ---**	8.3 / 5.1	8.2 / 4.8	13,6 / 5,0	13.5 / 4.7
3.4	**Heating water flow with an internal pressure differential of**		**m³/h / Pa**	0.75 / 7000	1.4 / 24000	1.3 / 7000	2.3 / 22000
3.5	**Cold water flow at an internal pressure differential of (heat source)**		**m³/h / Pa**	2,0 / 6200		3,3 / 19000	
3.6	**Refrigerant; total filling weight**		**type / kg**	R407C / 1.7		R407C / 1.9	
4	**Dimensions, connections and weight**						
4.1	**Device dimensions without connections** [2]		**H x W x L mm**	1445 x 650 x 575		1445 x 650 x 575	
4.2	**Device connections to heating system**		**Inch**	Thread 1¼" external		Thread 1¼" external	
4.3	**Device connections to heat source**		**Inch**	Thread 1¼" external		Thread 1¼" external	
4.4	**Weight of the transportable unit(s) incl. packing**		**kg**	156		165	
5	**Electrical Connection**						
5.1	**Nominal voltage; fuse protection**		**V / A**	230 / 16		230 / 25	
5.2	**Nominal power consumption** [1]	**W10 W35**	**kW**	1.62	1.69	2.72	2.87
5.3	**Starting current with soft starter**		**A**	26		45	
5.4	**Nominal current W10 W35 / cos φ**		**A / ---**	8.0	9.18	14.8	16.6
6	**Complies with the European safety regulations**			[3]		[3]	
7	**Additional model features**						
7.1	**Water in device protected against freezing** [4]			Yes		Yes	
7.2	**Performance levels**			1		1	
7.3	**Controller internal/external**			Internal		Internal	

1. This data indicates the size and capacity of the system according to EN 255 or EN 14511. For an analysis of the economic and energy efficiency of the system, bivalence point and regulation should also be taken into consideration. The specified values, e.g. W10 / W55, have the following meaning: Heat source temperature 10 °C and heating water flow temperature 55 °C.
2. Note that additional space is required for pipe connections, operation and maintenance.
3. See CE declaration of conformity
4. The heat circulating pump and the heat pump controller must always be ready for operation.

4.6 Device Information for Water-to-Water Heat Pumps (3-Phase, 400 V AC)

4.6.1 Low-temperature heat pumps WI 9TE to WI 27TE

Device information for water-to-water heat pumps (heating only)																
1	**Type and order code**			WI 9TE		WI 14TE		WI 18TE		WI 22TE		WI 27TE	
2	**Design**												
2.1	**Degree of protection according to EN 60 529**			IP20		IP20		IP20		IP20		IP20	
2.2	**Installation Location**			Indoors		Indoors		Indoors		Indoors		Indoors	
3	**Performance data**												
3.1	**Operating temperature limits:**												
	Heating water flow		**°C**	Up to 58		Up to 58		Up to 58		Up to 58		Up to 58	
	Cold water (heat source)		**° C**	+7 to +25		+7 to +25		+7 to +25		+7 to +25		+7 to +25	
3.2	**Temperature spread of heating water at W10 / W35K**			9.5	5.0	8.8	5.0	9.2	5.0	9.6	5.0	9.4	5.0
3.3	**Heat output / COP**	**at W7 / W55 [1]**	**kW / ---**	6.9 / 2.5		12.2 / 2.5		14.9 / 3.0		19.0 / 3.2		24.6 / 3.2	
		at W10 / W50 [1]	**kW / ---**	7.7 / 3,2		13.4 / 3.6		16.3 / 3.7		20.8 / 3.8		26.4 / 3.8	
		at W10 / W45 [1]	**kW / ---**		7.6 / 3.5		13.2 / 3.8		16.1 / 4.0		20.5 / 4.0		26.0 / 4.1
		at W10 / W35 [1]	**kW / ---**	8.3 / 5.1	8.2 / 4.9	13.6 / 5.2	13.5 / 5.0	17.1 / 5.3	16.9 / 5.2	21.5 / 5.5	21.3 / 5.3	26.4 / 5.1	26.1 / 4.9
3.4	**Sound power level**		**dB(A)**	53		55		55		58		59	
3.5	**Heating water flow with an internal pressure differential of**		**m³/h / Pa**	0.75 / 7000	1.4 / 24000	1.3 / 7000	2.3 / 22000	1.6 / 2600	2.8 / 7600	2.0 / 8000	3.7 / 24300	2.4 / 12500	4.5 / 36000
3.6	**Cold water flow at an internal pressure differential of (heat source)**		**m³/h / Pa**	2.0 / 6200	1.9 / 5600	3.3 / 19000	3.2 / 13000	4.0 / 12000	3.6 / 9500	5.0 / 20000	4.8 / 17900	7.0 / 16000	6.7 / 14900
3.7	**Refrigerant; total filling weight**		**type / kg**	R407C / 1.7		R407C / 1.6		R407C / 3.5		R407C / 3.2		R407C / 4.5	
4	**Dimensions, connections and weight**												
4.1	**Device dimensions without connections [2]**		**H x W x L mm**	1445 x 650 x 575		1445 x 650 x 575		1445 x 650 x 575		1445 x 650 x 575		1445 x 650 x 575	
4.2	**Device connections to heating system**		**Inch**	Thread 1¼" external		Thread 1¼" external		Thread 1¼" external		Thread 1¼" external		Thread 1¼" external	
4.3	**Device connections to heat source**		**Inch**	Thread 1¼" external		Thread 1¼" external		Thread 1½" a		Thread 1½" a		Thread 1½" a	
4.4	**Weight of the transportable unit(s) incl. packing**		**kg**	156		168		187		189		259	
5	**Electrical Connection**												
5.1	**Nominal voltage; fuse protection**		**V / A**	400 / 16		400 / 16		400 / 16		400 / 20		400 / 20	
5.2	**Nominal power consumption [1]**	**W10 W35**	**kW**	1.62	1.68	2.64	2.72	3.21	3.27	3.93	4.02	5.15	5.29
5.3	**Starting current with soft starter**		**A**	30 (without SS)		26		28		27		29	
5.4	**Nominal current W10 W35 / cos φ**		**A / ---**	2.9 / 0.8	3.03 / 0.8	4.8 / 0.8	4.91 / 0.8	5.8 / 0.8	5.90 / 0.8	7.0 / 0.8	7.25 / 0.8	9.4 / 0.8	9.54 / 0.8
6	**Complies with the European safety regulations**			3		3		3		3		3	
7	**Additional model features**												
7.1	**Water in device protected against freezing [4]**			Yes		Yes		Yes		Yes		Yes	
7.2	**Performance levels**			1		1		1		1		1	
7.3	**Controller internal/external**			Internal		Internal		Internal		Internal		Internal	

1. This data indicates the size and capacity of the system according to EN 255 or EN 14511. For an analysis of the economic and energy efficiency of the system, bivalence point and regulation should also be taken into consideration. The specified values, e.g. W10 / W55, have the following meaning: Heat source temperature 10 °C and heating water flow temperature 55 °C.
2. Note that additional space is required for pipe connections, operation and maintenance.
3. See CE declaration of conformity
4. The heat circulating pump and the heat pump controller must always be ready for operation.

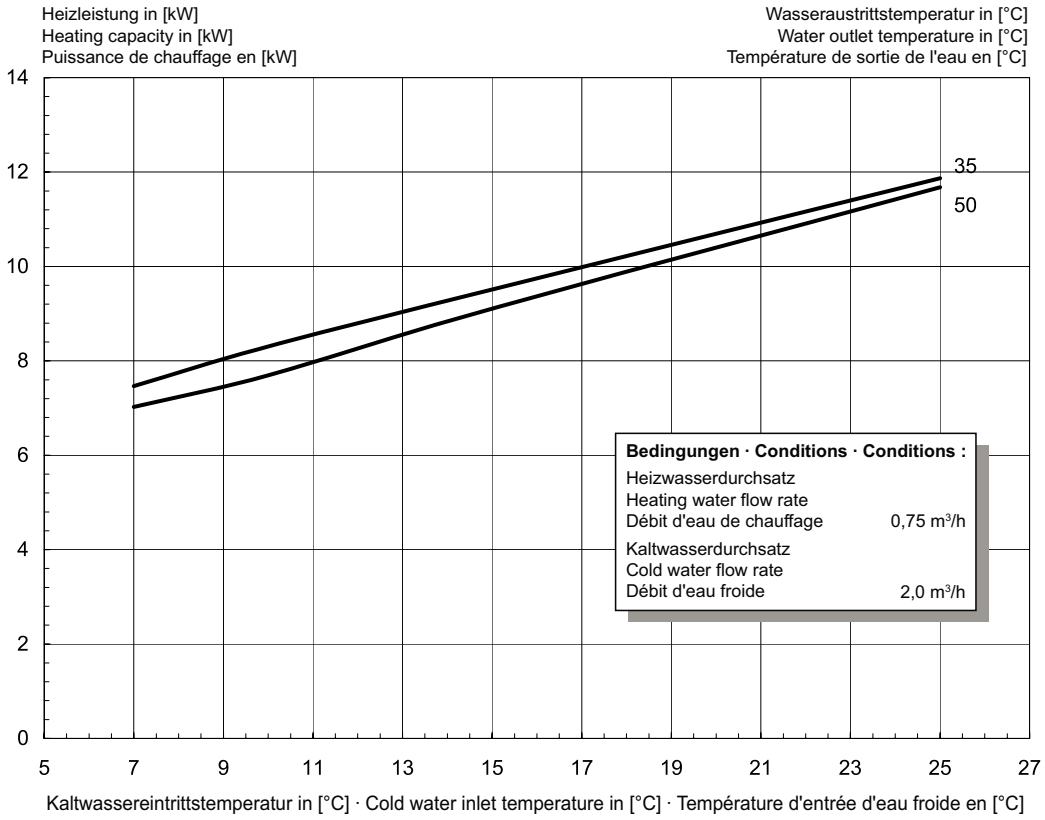
4.6.2 Low-temperature heat pumps with 2 compressors WI 40CG to WI 90CG

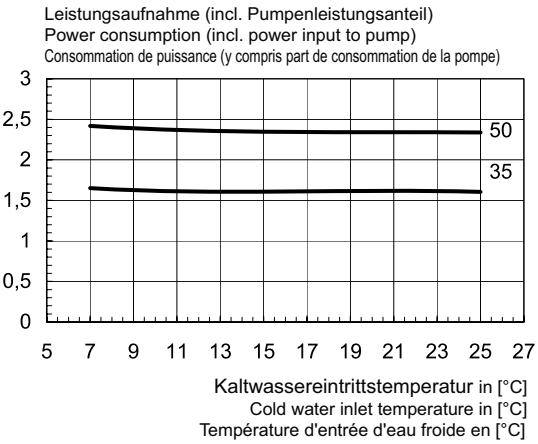
Device information for water-to-water heat pumps (heating only)						
1	**Type and order code**				WI 40CG	WI 90CG
2	**Design**					
2.1	**Degree of protection according to EN 60 529**				IP24	IP24
2.2	**Installation Location**				Indoors	Indoors
3	**Performance data**					
3.1	**Operating temperature limits:**					
	Heating water flow		**°C**		Up to 55	Up to 55
	Cold water (heat source)		**° C**		+7 to +25	+7 to +25
3.2	**Temperature spread of heating water (flow/return flow) at W10 / W35K**				10.8	9.9
3.3	**Heat output / COP**	**at W7 / W55** [1]	**kW / ---**	[2]	18.1 / 3.0	40.3 / 3.2
			kW / ---	[3]	38.6 / 3.2	80.1 / 3.2
		at W10 / W50 [1]	**kW / ---**	[2]	20.6 / 3.8	45.8 / 4.0
			kW / ---	[3]	43.0 / 4.0	88.1 / 3.8
		at W10 / W35 [1]	**kW / ---**	[2]	23.4 / 5.9	49.8 / 5.9
			kW / ---	[3]	44.4 / 5.7	91.2 / 5.4
3.4	**Sound power level**		**dB(A)**		59	70
3.5	**Heating water flow with an internal pressure differential of**		**m³/h / Pa**		3.5 / 14000	8.0 / 13000
3.6	**Cold water flow with an internal pressure differential of (heat source)**		**m³/h / Pa**		9.5 / 17500	20.0 / 19000
3.7	**Refrigerant; total filling weight**		**type / kg**		R407C / 6.7	R407C / 15.0
4	**Dimensions, connections and weight**					
4.1	**Device dimensions without connections** [4]		**H x W x L mm**		830 x 1480 x 890	830 x 1480 x 890
4.2	**Device connections to heating system**		**Inch**		Thread 1 1/4" external	Thread 2" external
4.3	**Device connections to heat source**		**Inch**		Thread 1 1/2" external	Thread 2" external
4.4	**Weight of the transportable unit(s) incl. packing**		**kg**		309	460
5	**Electrical Connection**					
5.1	**Nominal voltage; fuse protection**		**V / A**		400 / 35	400 / 63
5.2	**Nominal power consumption** [1] **W10 W35**		**kW**		7.81	16.97
5.3	**Starting current with soft starter**		**A**		26	60
5.4	**Nominal current W10 W35 / cos φ 5)**		**A / ---**		14.1 / 0.8	30.7 / 0.8
6	**Complies with the European safety regulations**				[5]	[5]
7	**Additional model features**					
7.1	**Water in device protected against freezing** [6]				No	No
7.2	**Performance levels**				2	2
7.3	**Controller internal/external**				External	External

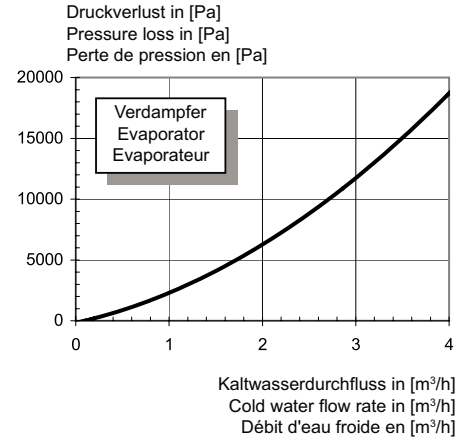
1. This data indicates the size and capacity of the system according to EN 255 or EN 14511. For an analysis of the economic and energy efficiency of the system, bivalence point and regulation should also be taken into consideration. The specified values, e.g. W10 / W55, have the following meaning: Heat source temperature 10 °C and heating water flow temperature 55 °C.
2. Operation with 1 compressors
3. Operation with 2 compressors
4. Note that additional space is required for pipe connections, operation and maintenance.
5. See CE declaration of conformity
6. Not required when installed in rooms protected from frost.

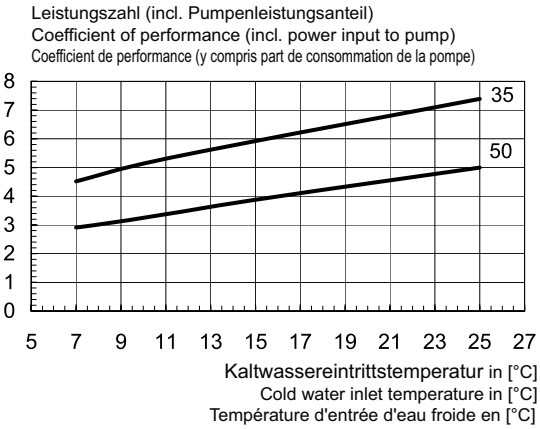
4.7 Characteristic Curves for Water-to-Water Heat Pumps (1-Phase, 230 V AC)

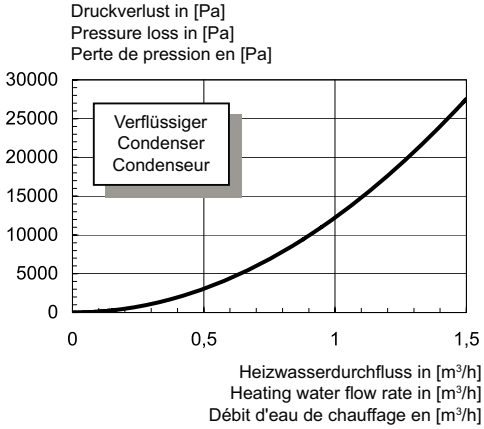
4.7.1 Characteristic curves WI 9ME



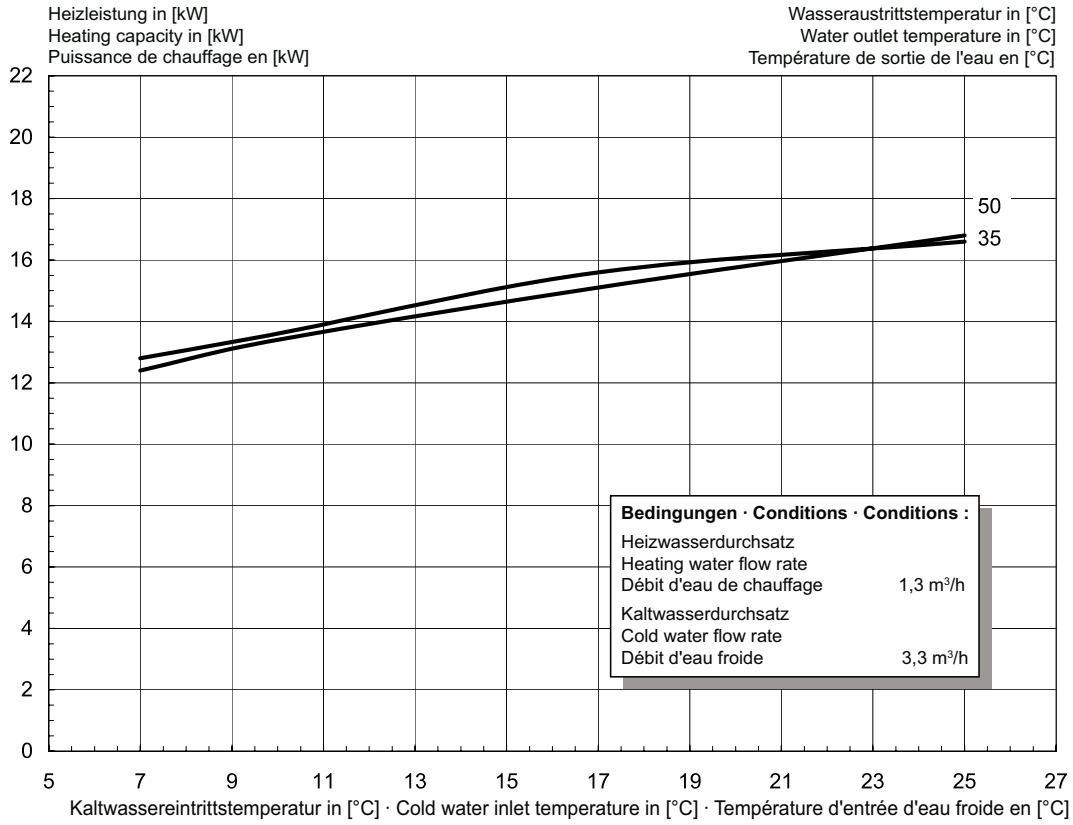


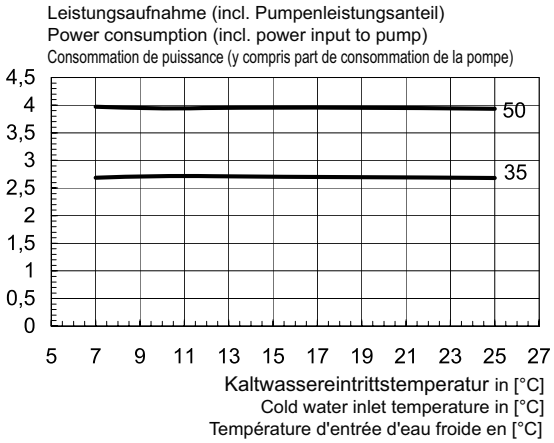


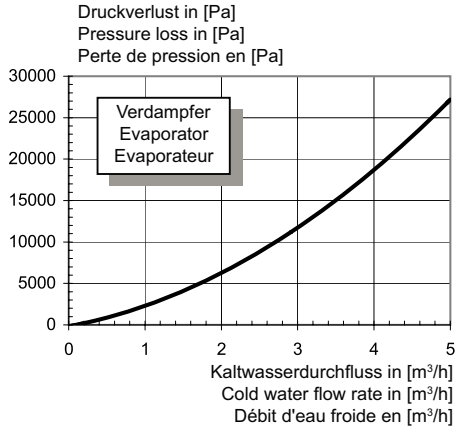


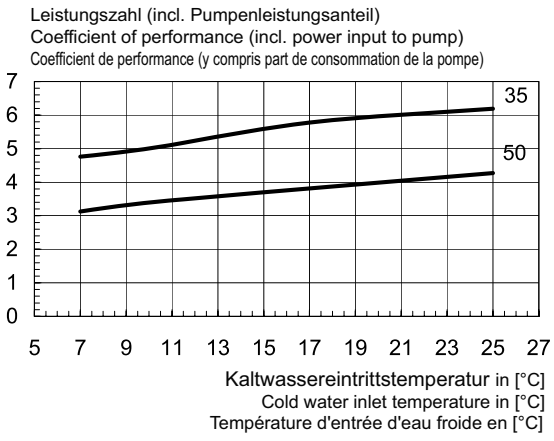


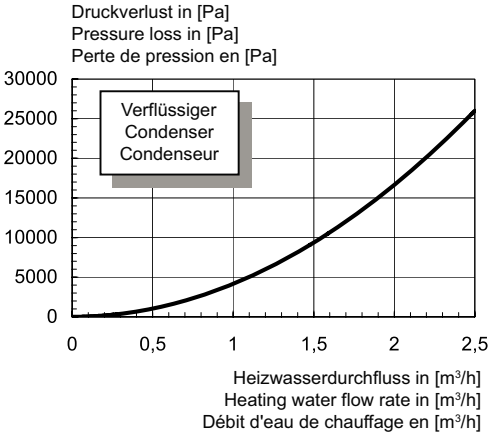
4.7.2 Characteristic curves WI 14ME





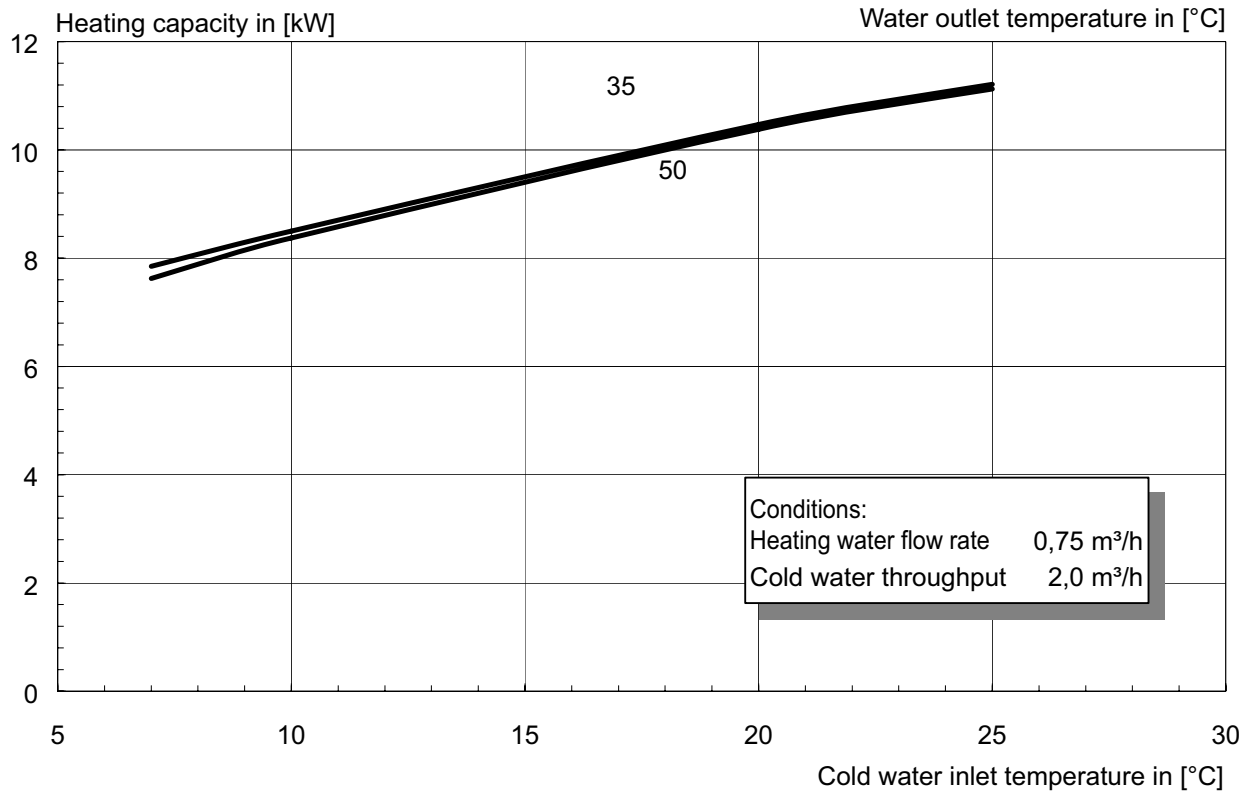


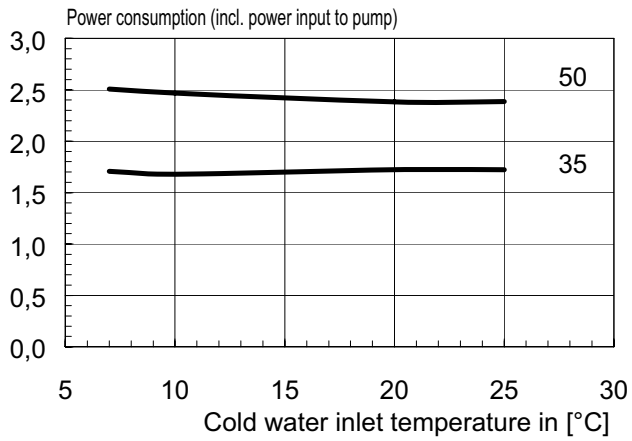


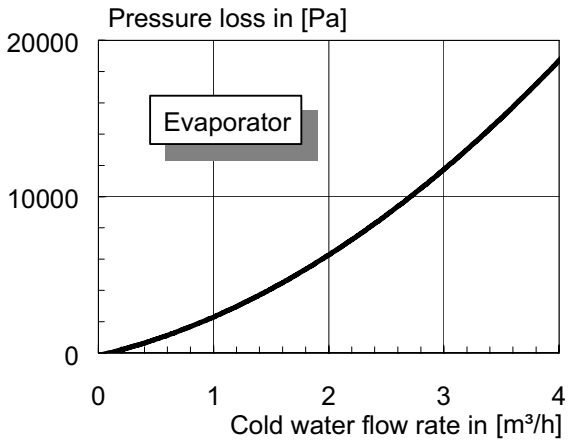


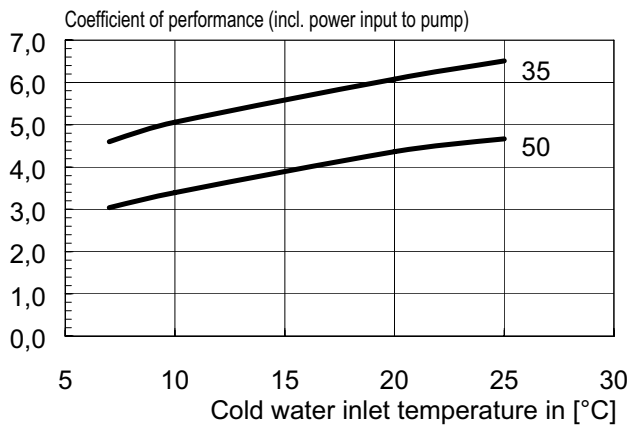
4.8 Characteristic Curves for Water-to-Water Heat Pumps (3-Phase, 400 V AC)

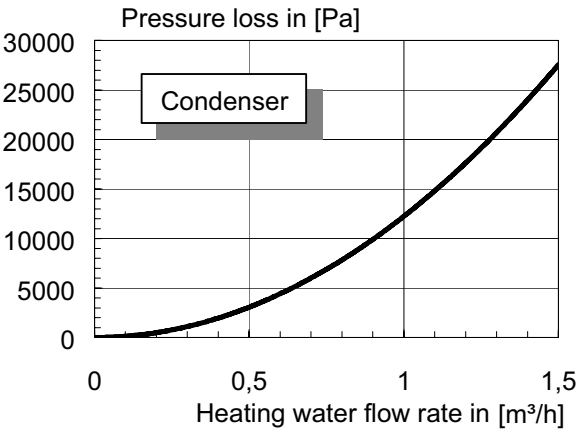
4.8.1 Characteristic curves WI 9TE



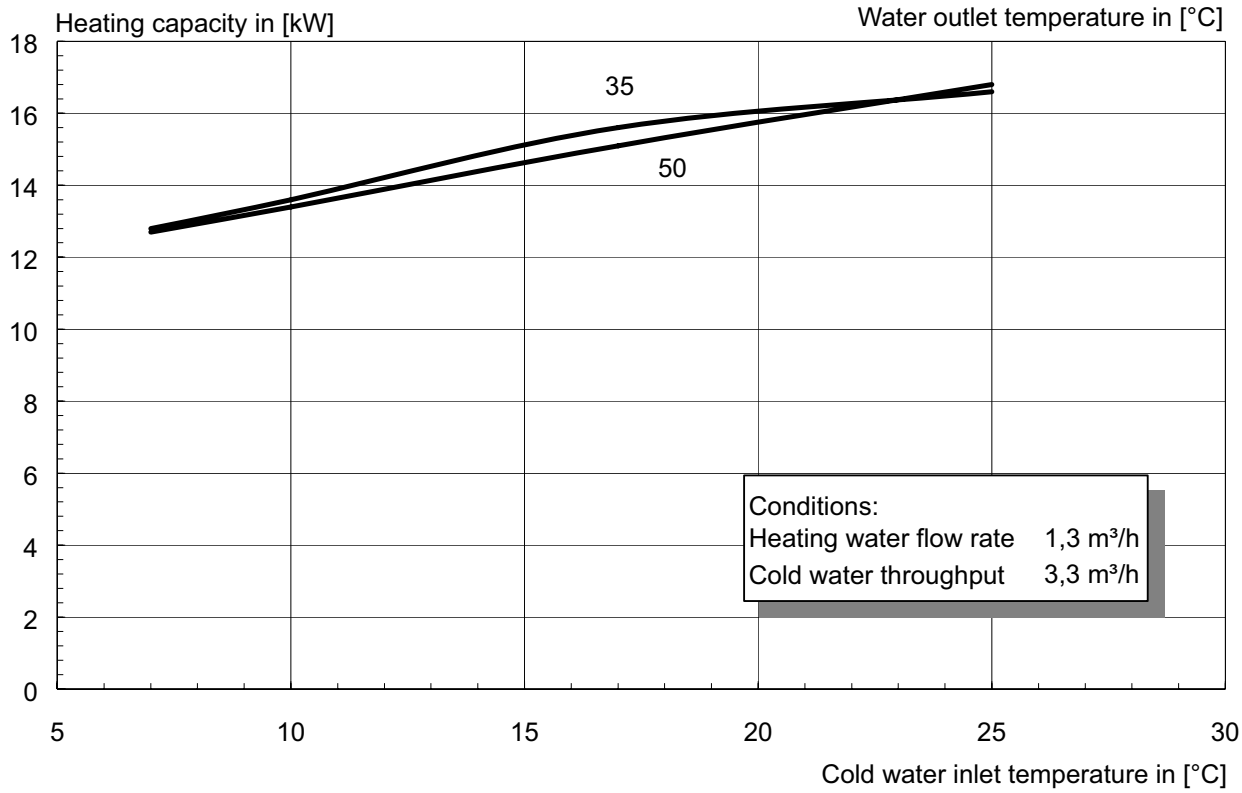


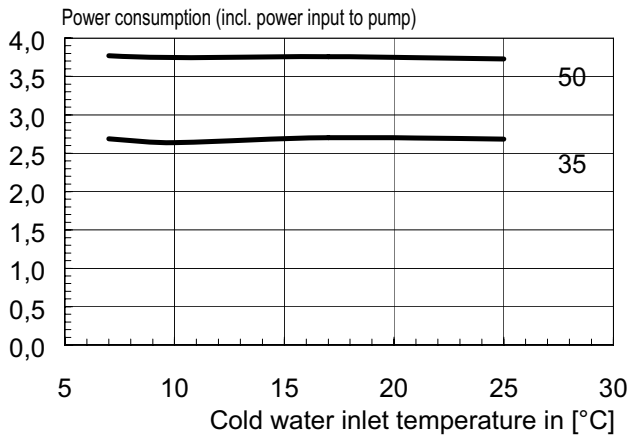


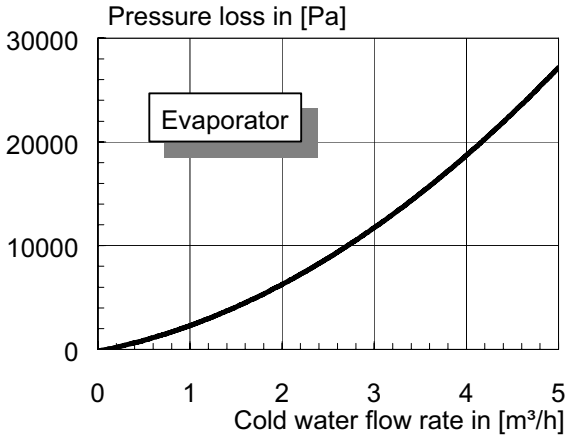


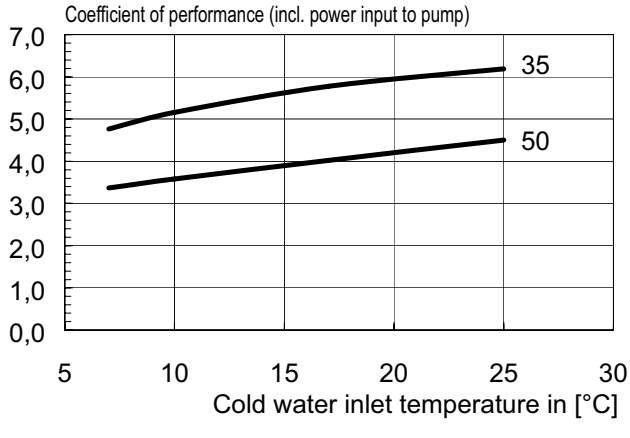


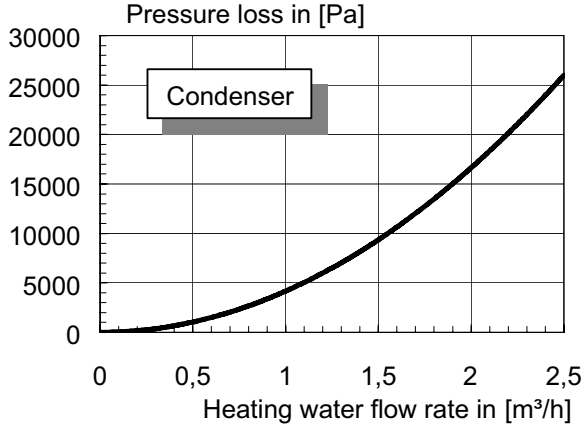
4.8.2 Characteristic curves WI 14TE



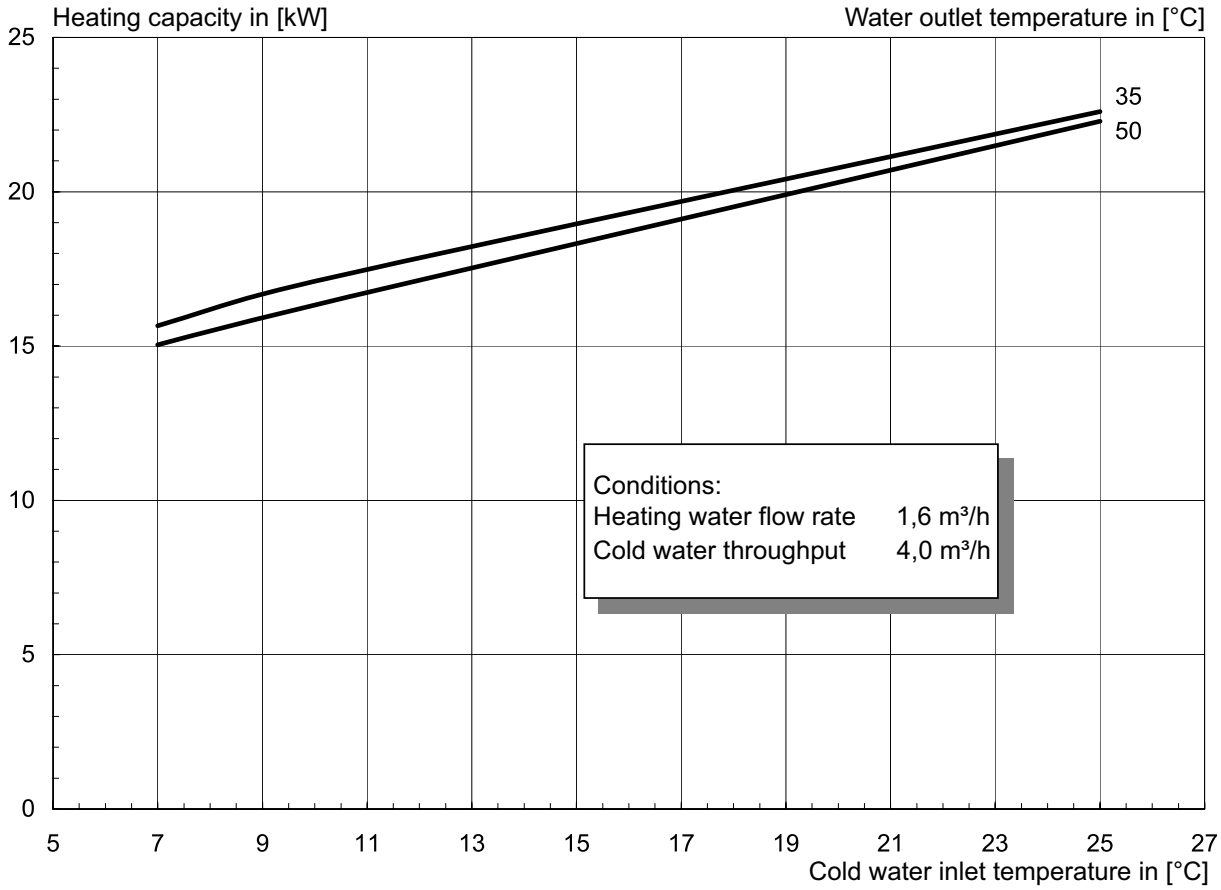


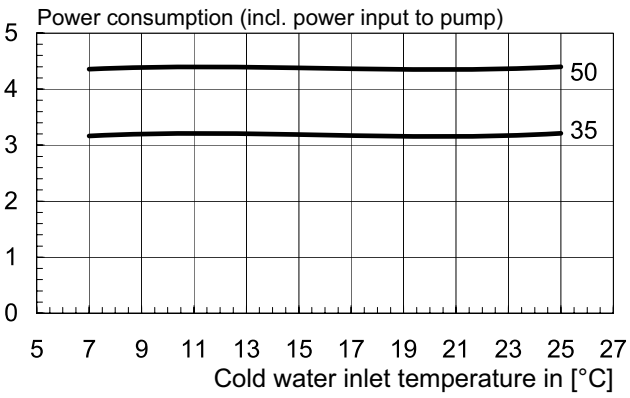


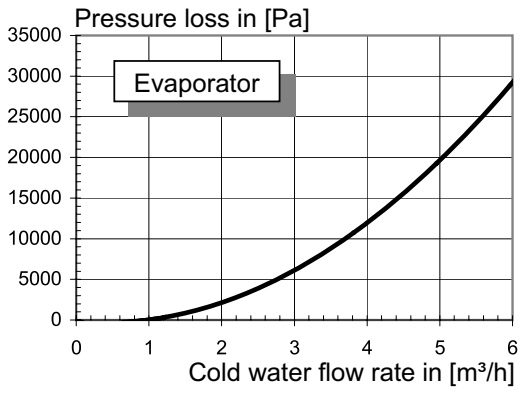


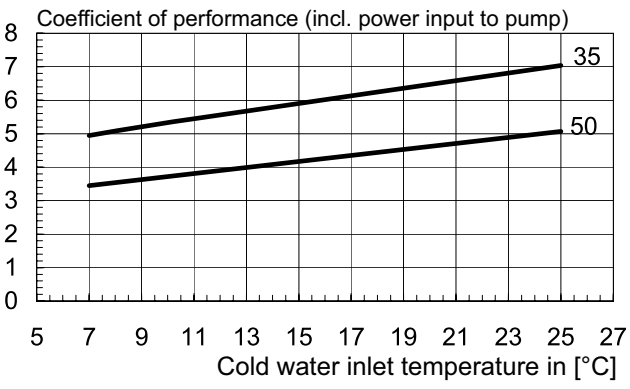


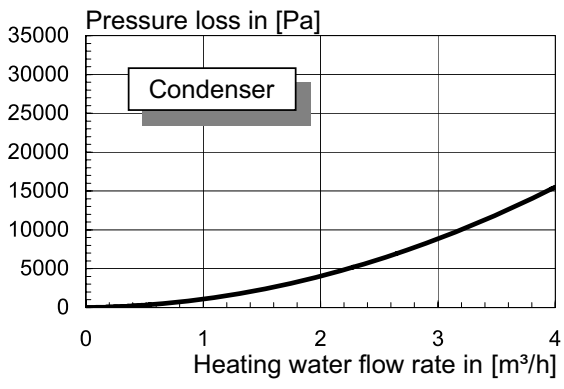
4.8.3 Characteristic curves WI 18TE



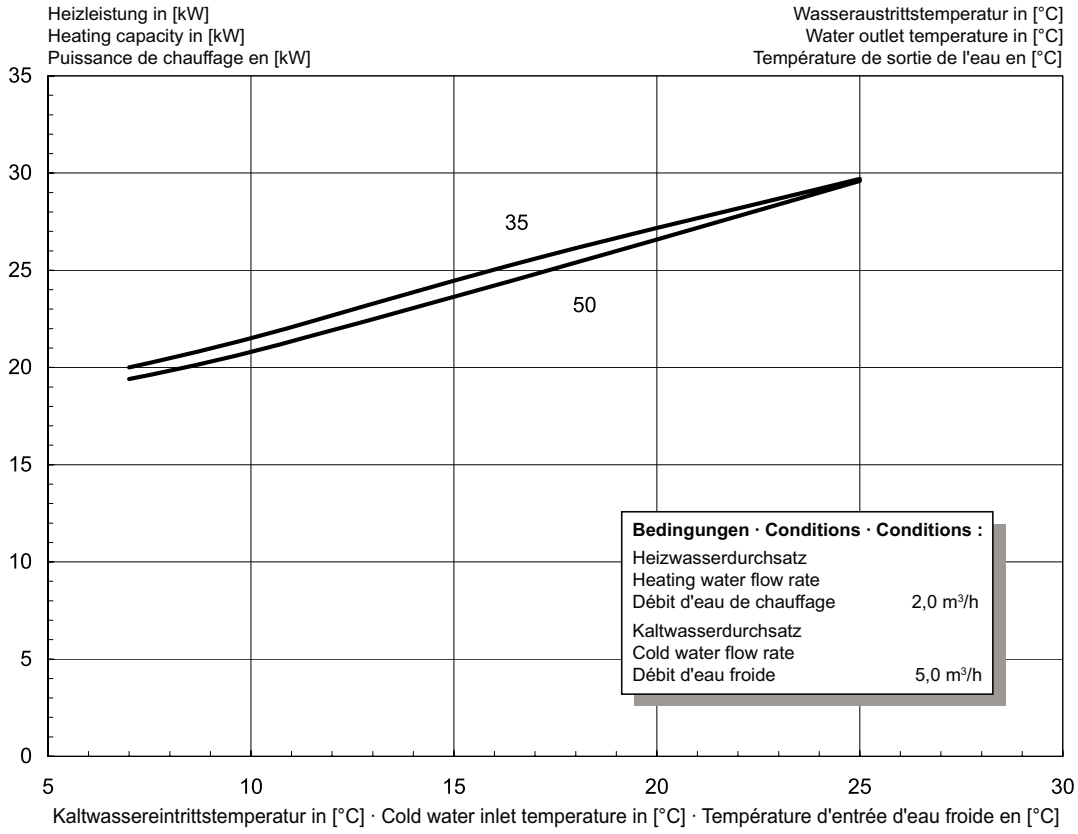


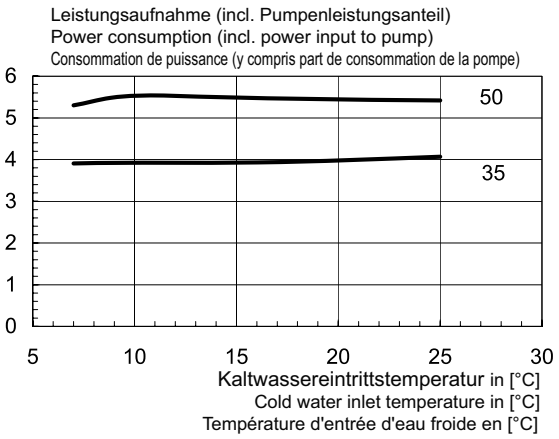


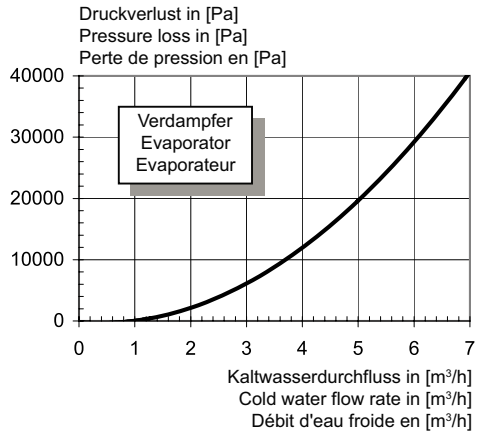


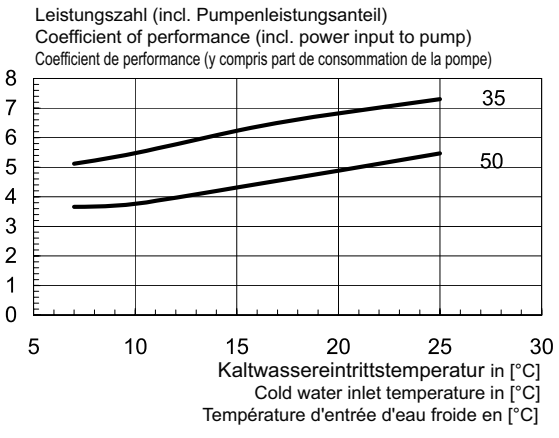


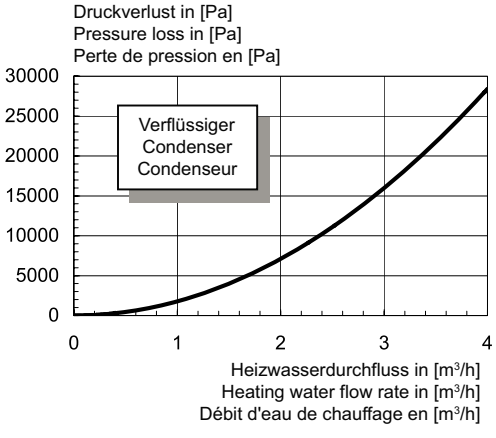
4.8.4 Characteristic curves WI 22TE


Heizleistung in [kW]
Heating capacity in [kW]
Puissance de chauffage en [kW]
Wasseraustrittstemperatur in [°C]
Water outlet temperature in [°C]
Température de sortie de l'eau en [°C]
35
50
Bedingungen · Conditions · Conditions :
Heizwasserdurchsatz
Heating water flow rate
Débit d'eau de chauffage 2,0 m³/h
Kaltwasserdurchsatz
Cold water flow rate
Débit d'eau froide 5,0 m³/h
Kaltwassereintrittstemperatur in [°C] · Cold water inlet temperature in [°C] · Température d'entrée d'eau froide en [°C]

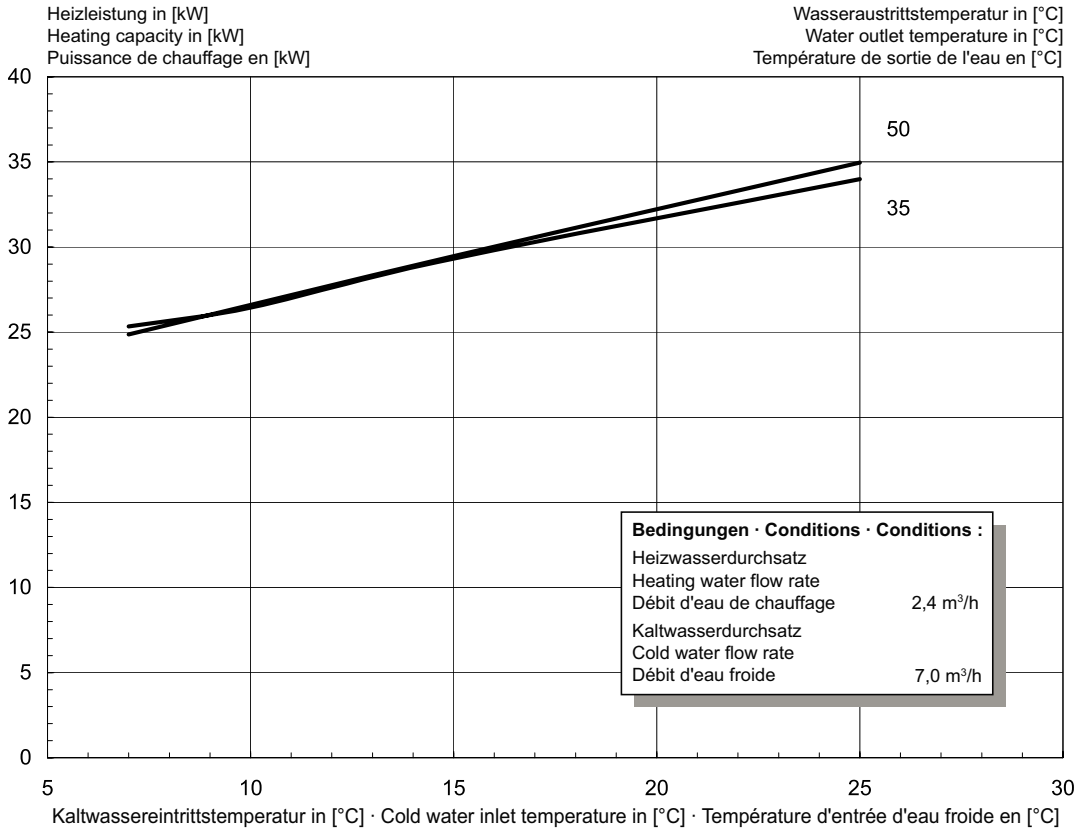

Leistungsaufnahme (incl. Pumpenleistungsanteil)
Power consumption (incl. power input to pump)
Consommation de puissance (y compris part de consommation de la pompe)
50
35
Kaltwassereintrittstemperatur in [°C]
Cold water inlet temperature in [°C]
Température d'entrée d'eau froide en [°C]

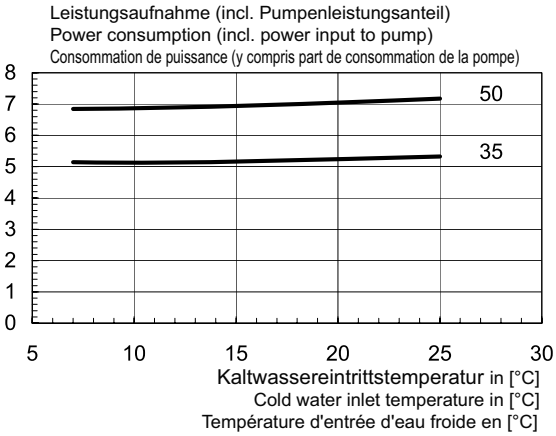


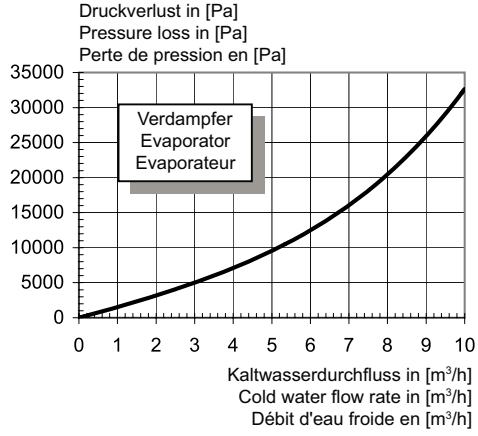

Leistungszahl (incl. Pumpenleistungsanteil)
Coefficient of performance (incl. power input to pump)
Coefficient de performance (y compris part de consommation de la pompe)
35
50
Kaltwassereintrittstemperatur in [°C]
Cold water inlet temperature in [°C]
Température d'entrée d'eau froide en [°C]

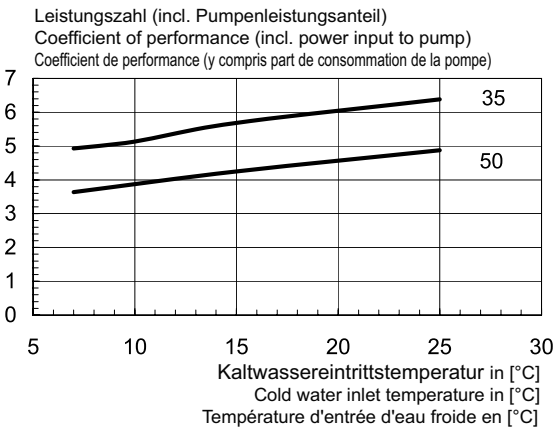


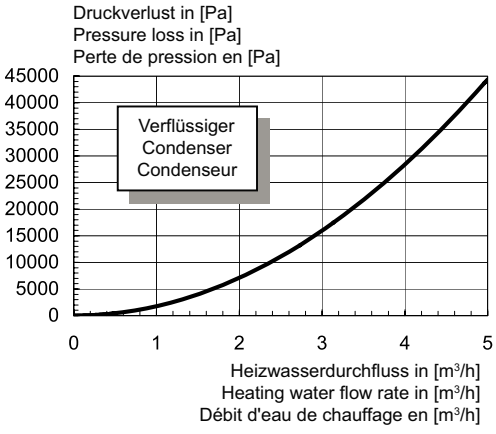
4.8.5 Characteristic curves WI 27TE


Heizleistung in [kW]
Heating capacity in [kW]
Puissance de chauffage en [kW]
Wasseraustrittstemperatur in [°C]
Water outlet temperature in [°C]
Température de sortie de l'eau en [°C]
50
35
Bedingungen · Conditions · Conditions :
Heizwasserdurchsatz
Heating water flow rate
Débit d'eau de chauffage 2,4 m³/h
Kaltwasserdurchsatz
Cold water flow rate
Débit d'eau froide 7,0 m³/h
Kaltwassereintrittstemperatur in [°C] · Cold water inlet temperature in [°C] · Température d'entrée d'eau froide en [°C]

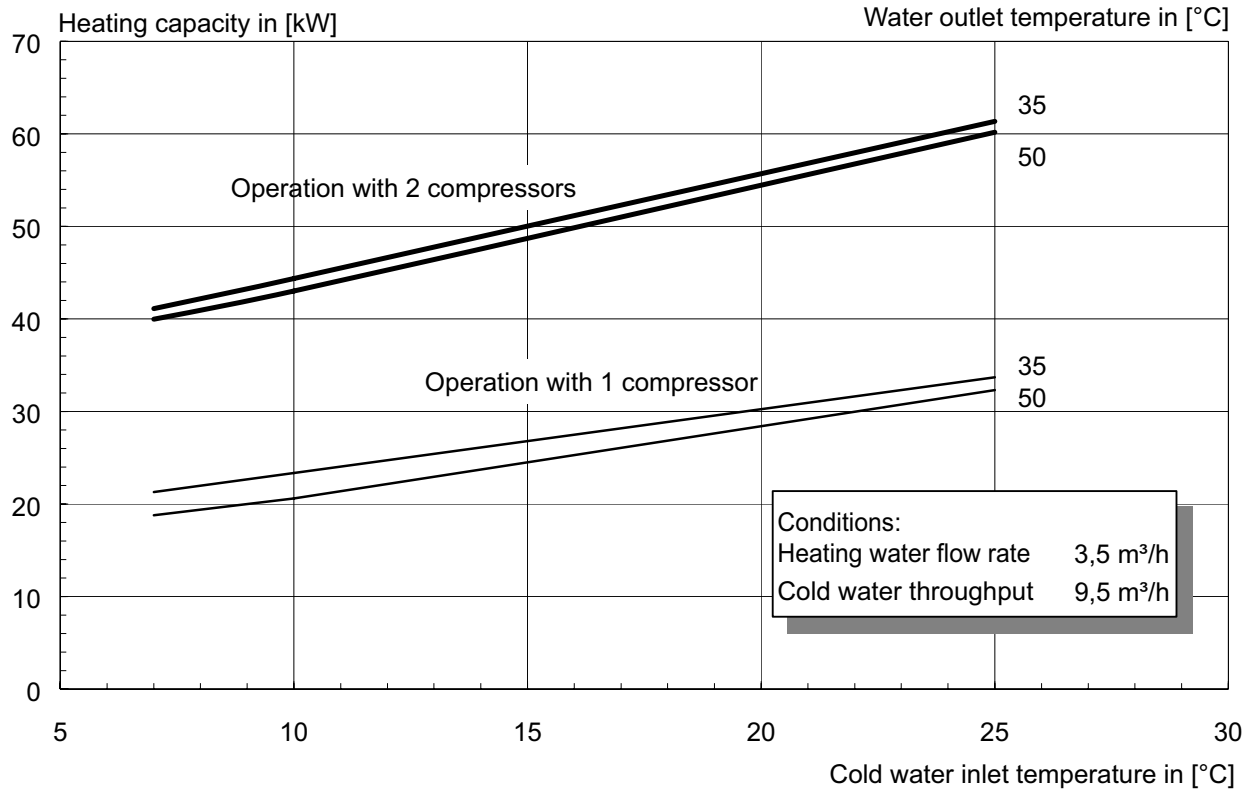

Leistungsaufnahme (incl. Pumpenleistungsanteil)
Power consumption (incl. power input to pump)
Consommation de puissance (y compris part de consommation de la pompe)
50
35
Kaltwassereintrittstemperatur in [°C]
Cold water inlet temperature in [°C]
Température d'entrée d'eau froide en [°C]

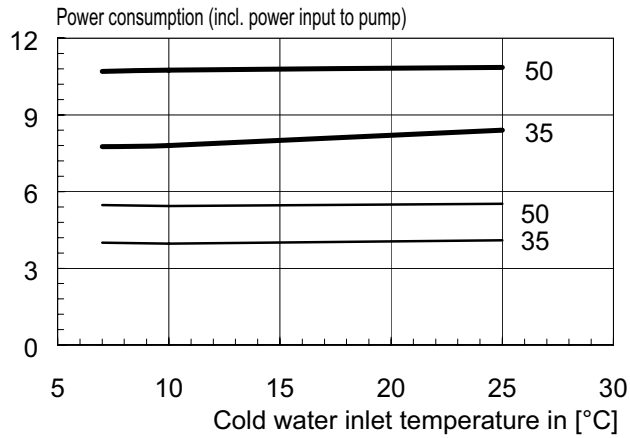


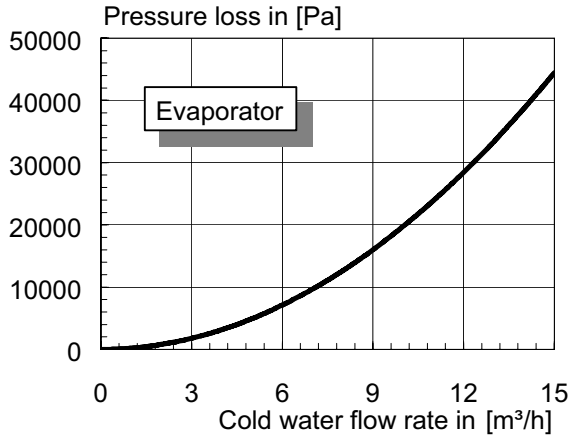

Leistungszahl (incl. Pumpenleistungsanteil)
Coefficient of performance (incl. power input to pump)
Coefficient de performance (y compris part de consommation de la pompe)
35
50
Kaltwassereintrittstemperatur in [°C]
Cold water inlet temperature in [°C]
Température d'entrée d'eau froide en [°C]

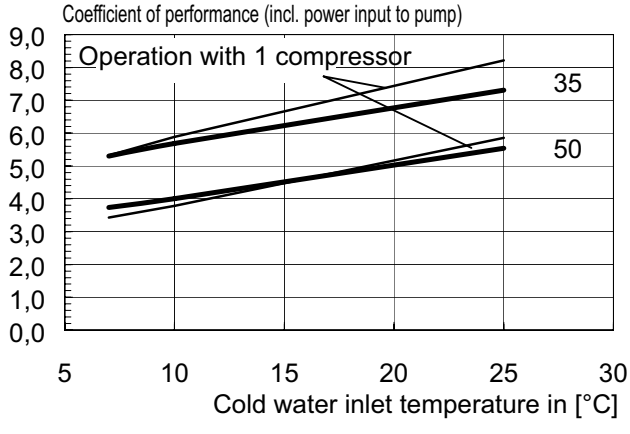


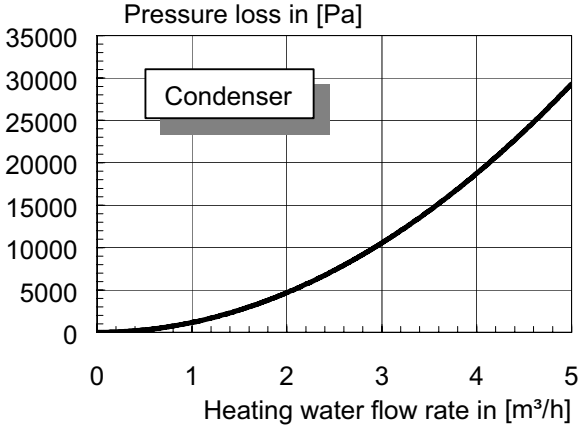
4.8.6 Characteristic curves WI 40CG



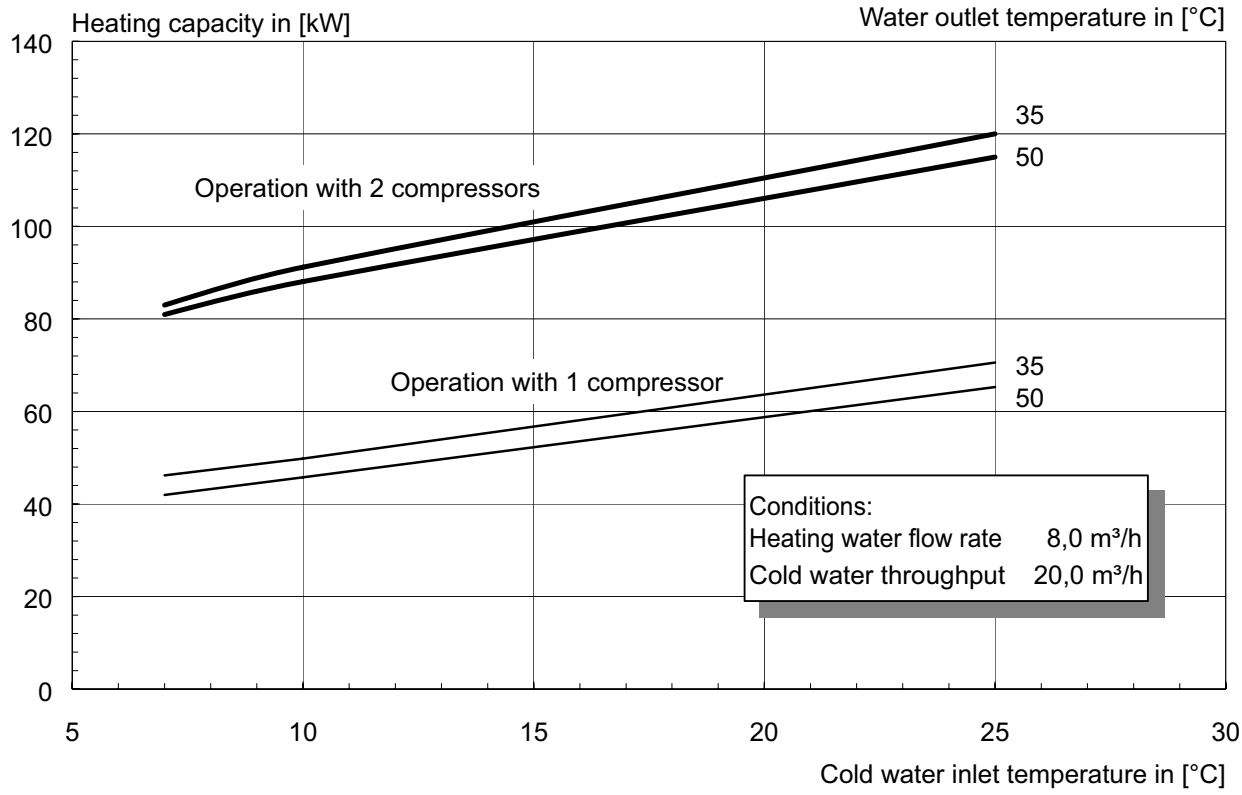


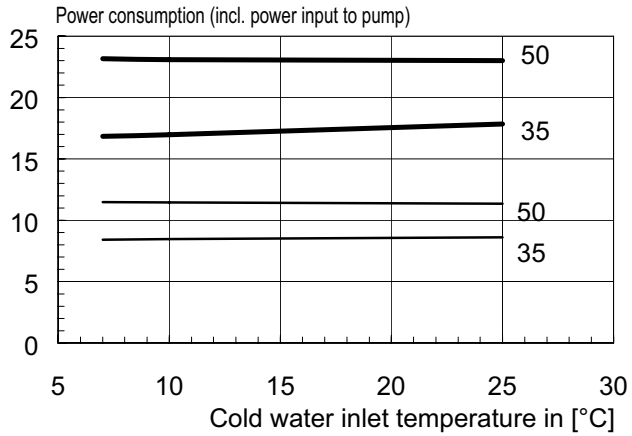


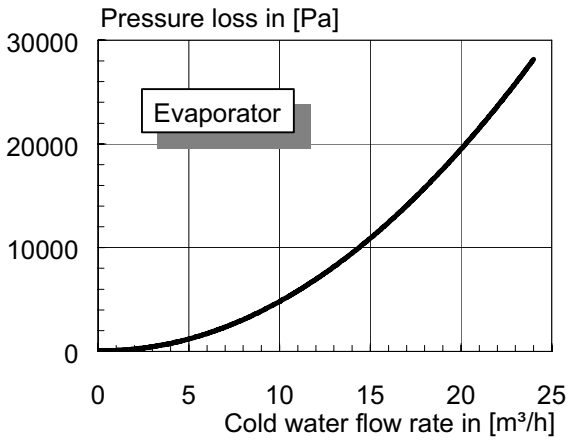


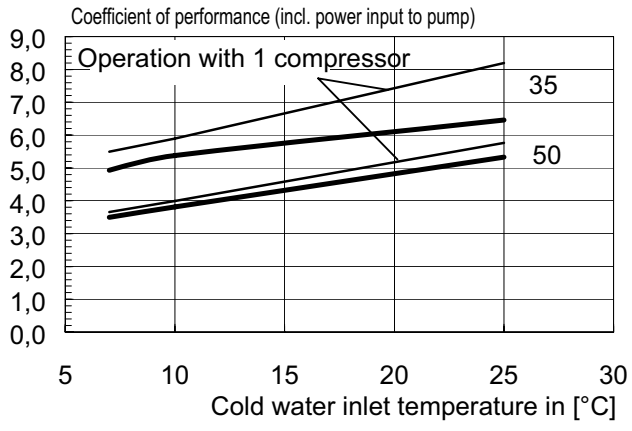


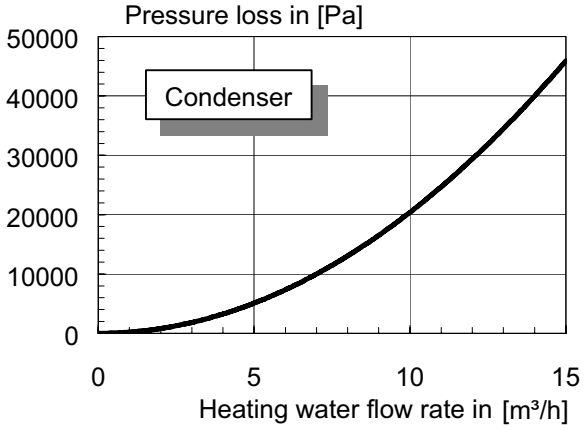
4.8.7 Characteristic curves WI 90CG





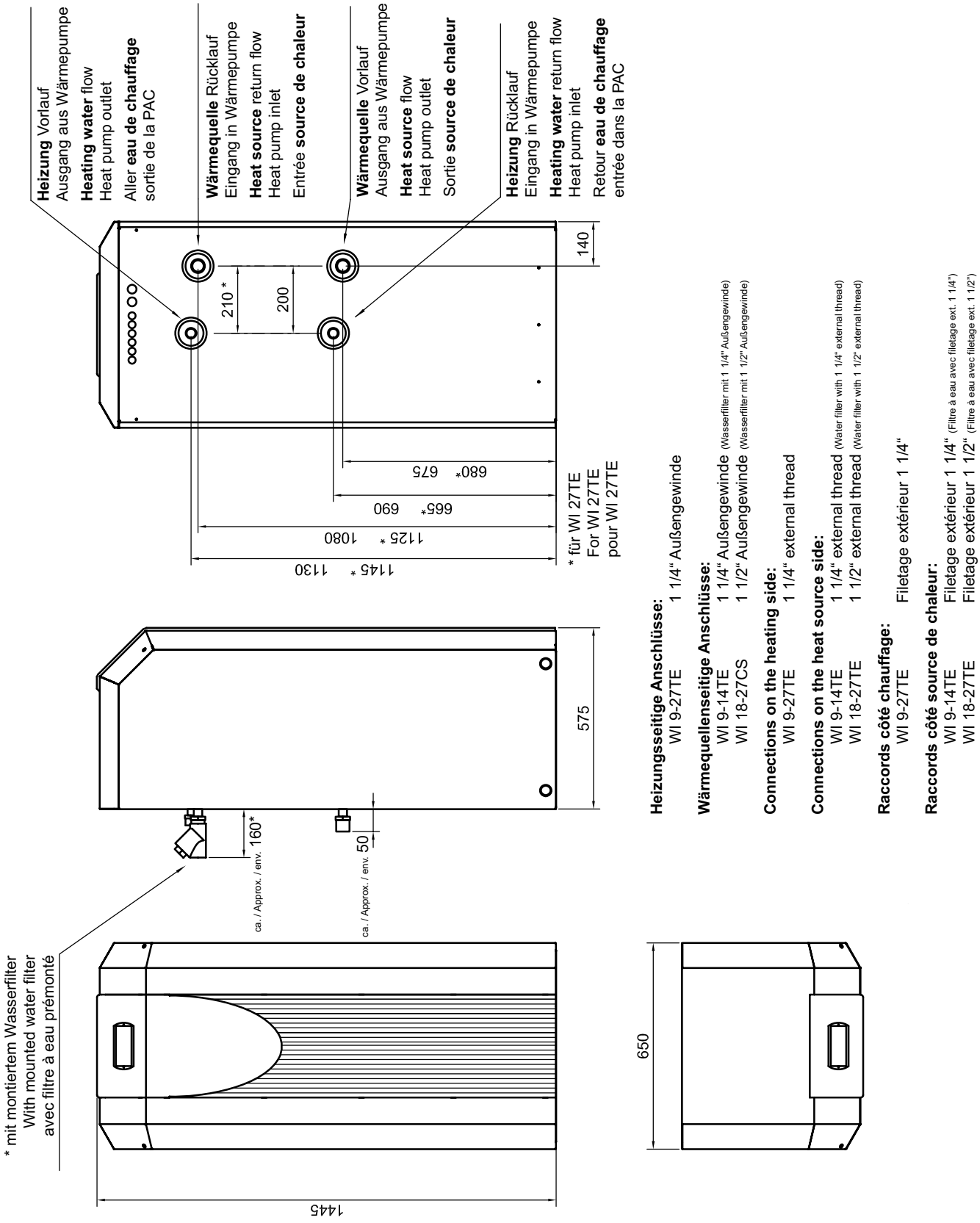






4.9 Dimensions of Water-to-Water Heat Pumps

4.9.1 Dimensions WI 9ME, WI 14ME, WI 9TE, WI 14TE, WI 18TE, WI 22TE and WI 27TE



Heizungsseitige Anschlüsse:
WI 9-27TE 1 1/4" Außengewinde

Wärmequellenseitige Anschlüsse:
WI 9-14TE 1 1/4" Außengewinde (Wasserfilter mit 1 1/4" Außengewinde)
WI 18-27CS 1 1/2" Außengewinde (Wasserfilter mit 1 1/2" Außengewinde)

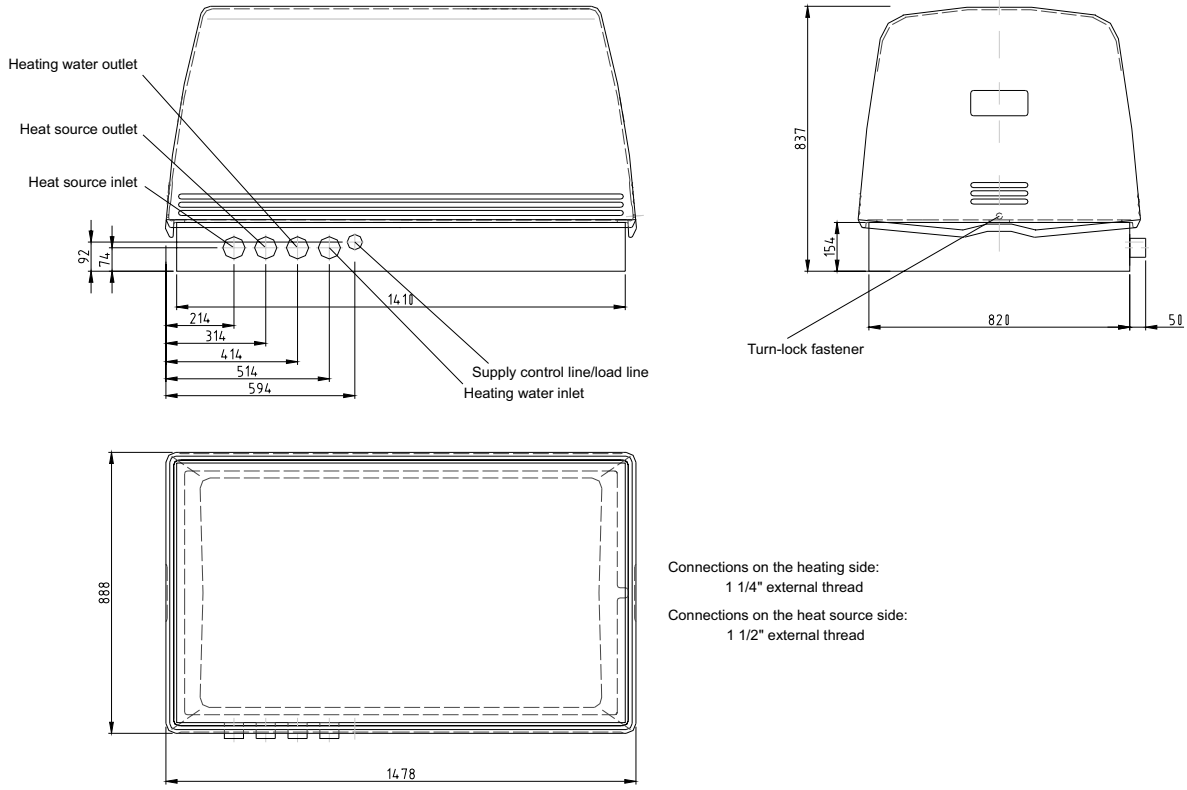
Connections on the heating side:
WI 9-27TE 1 1/4" external thread

Connections on the heat source side:
WI 9-14TE 1 1/4" external thread (Water filter with 1 1/4" external thread)
WI 18-27TE 1 1/2" external thread (Water filter with 1 1/2" external thread)

Raccords côté chauffage:
WI 9-27TE Filetage extérieur 1 1/4"

Raccords côté source de chaleur:
WI 9-14TE Filetage extérieur 1 1/4" (Filtre à eau avec filetage ext. 1 1/4")
WI 18-27TE Filetage extérieur 1 1/2" (Filtre à eau avec filetage ext. 1 1/2")

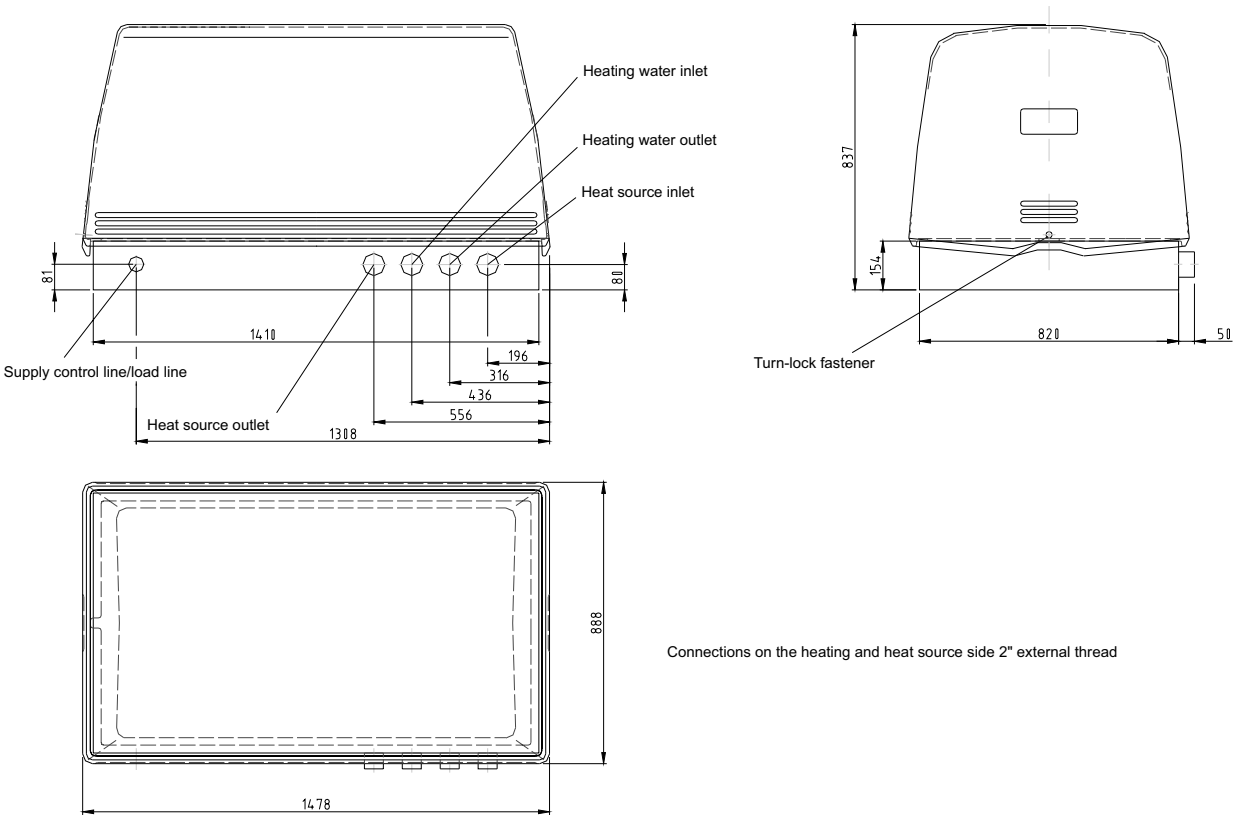
4.9.2 Dimensions WI 40CG



Connections on the heating side:
1 1/4" external thread

Connections on the heat source side:
1 1/2" external thread

4.9.3 Dimensions WI 90CG



Connections on the heating and heat source side 2" external thread

5 Noise Emissions from Heat Pumps

5.1 Solid-Borne Sound

Indoor installation

Like any boiler, heat pumps should be connected with isolating fixings. The heat pump should be connected to the heating flow and return flow with pressure-resistant-, temperature-resistant, non-ageing, flexible hoses to prevent vibrations being transmitted.

For reducing the transmission of solid-borne sound, the heat pump should be set upon the SYL 250 sylomer strips (available as accessory).

Outdoor installation

Solid-borne sound insulation is only necessary if the heat pump's foundation is in direct contact with the building. Flexible hoses facilitate the connection of the heat pump to the heat system and simultaneously prevent any vibrations from being transmitted.

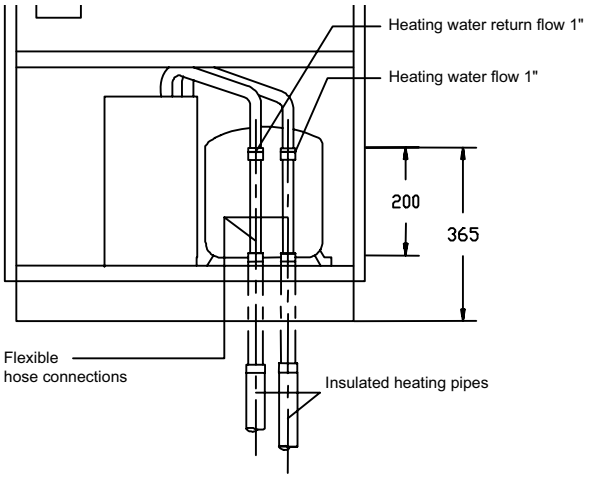


Fig. 5.1: Example of how a heat pump is integrated when installed outdoors

5.2 Airborne Sound

Every noise source - be it a heat pump, a car or an airplane - emits a certain amount of sound. Thus, the air surrounding the source of noise is turned into vibrations and the pressure spreads out in waves. Once it reaches the human ear, this pressure wave vibrates the ear drum, which then triggers the act of hearing.
The sound field dimension serves as a description of this so-called airborne sound. Two of these are the sound pressure and the sound power.
Sound power is a theoretical dimension typical for a sound source. It can be mathematically calculated from measurements. The sound power consists of the total sound energy radiated in all directions.
Sound pressure refers to the change in air pressure caused by the air vibrated by the source of noise. The greater the change in the air pressure, the louder the noise will be perceived.

Physically speaking, sound is caused by the propagation of pressure and density fluctuations in a gas, liquid or solid. Generally, sound is absorbed (i.e. heard) by human beings in the form of airborne sound as a noise, tone or bang. Pressure changes in the range between $2*10^{-5}$ Pa to 20 Pa can be detected by human hearing. These pressure changes correspond to vibrations with frequencies between 20 Hz and 20kHz and represent the human audible sound or the range of audibility. The frequencies result in individual tones. Frequencies that are above of the range of audibility are referred to as ultrasonic sound, those below as infrasonic sound.

The sound transmissions from noise or other sources of sound are given or measured in decibels (dB). This is referred to here as a reference value, in which the value 0dB generally represents the auditory threshold. A doubling of the sound level, i.e. by a second source of sound with equal sound transmission, corresponds to an increase of +3dB. For the average human sense of hearing, an increase of +10dB is necessary so that a noise is perceived as twice as loud.

5.2.1 Sound Pressure Level and Sound Power Level

The terms, sound pressure level and sound power level, are frequently confused and compared with each other. In acoustics, sound pressure refers to the metrologically calculated level that is triggered by a sound source at a certain distance. The closer the sound source, the greater the measured sound pressure level and vice versa. Thus, the sound pressure level is a measurable dimension, that is dependent upon distance and direction; it is, for example a decisive factor for adherence to the immission standards according to the German government's Technical Instructions for Noise.

The total air pressure, given off in all directions by a sound source, is denoted as sound power or as sound power level. Increasing distance from the sound source causes the sound power to spread out upon an ever-increasing surface. The value will remain unchanged as long as the total emitted sound power is taken into consideration with reference to the enveloping surface at a specified distance. Because the sound power emitted in all directions cannot be precisely calculated metrologically, the sound power must be determined from a measured sound pressure at a specified distance. Thus, the sound power level is specific to the source of sound, independent of distance and direction, and can only be only be determined via mathematical calculation. Based on the emitted sound power level, sound sources can be compared with each other.

5.2.2 Emission and Immission

The total sound emitted from a sound source (sound event) is referred to as acoustic emission. Sound source emissions are generally denoted as sound power level. The effect of sound upon a specified location is referred to as acoustic immission. Acoustic immissions can be measured as the sound pressure

level. *Fig. 5.2 on p. 145* graphically depicts the interrelationship between emissions and immissions.

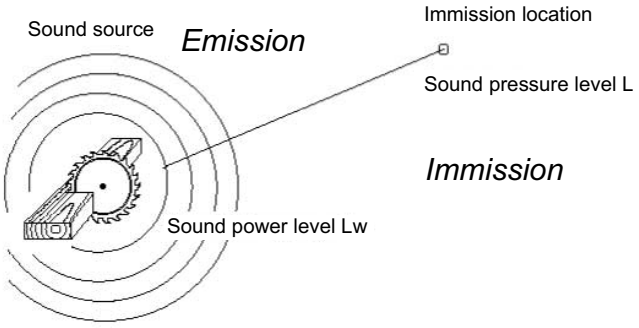


Fig. 5.2: Emission and immission

Noise immissions are measured in dB(A), meaning sound level values in relation to the sensitivity of the human sense of hearing. Noise refers to the sound that disturbs neighbours or third parties, and is extremely disadvantageous or potentially hazardous to these. Guideline values for noise at immission sites outside of buildings are stipulated in the DIN 18005 "Sound Protection in City Buildings" or in the "German government's Technical Instructions for Noise" (TA). The requirements according to the TA for noise are listed in table 5.1 on page 108.

Regional categories	Day	Night
Hospitals and health spa facilities	45	35
Schools, nursing homes	45	35
Allotments, parks	55	55
Residential areas WR	50	35
General residential areas WA	55	40
Housing estates WS	55	40
Special residential areas WB	60	40
Central areas MK	65	50
Village areas MD	60	45
Mixed-use areas MI	60	45
Trading estates GE	65	50
Industrial areas GI	70	70

Table 5.1: Limit values for noise immissions in dB(A) according to DIN 18005 and the German government's Technical Instructions on Noise

Sound source	Sound level [dB]	Sound pressure [μPa]	Perception
Absolute silence **Inaudible**	0 10	20 63	Inaudible
Ticking of a pocket watch, quiet bedroom	20	200	Very quiet
Very quiet garden, air conditioning in a theatre	30	630	Very quiet
Residential area without traffic, air conditioning in offices	40	2 * 10	Quiet
Slow-moving brook or river, quiet restaurant	50	6.3 * 10	Quiet
Normal conversation, car	60	$2 * 10^4$	Loud
Loud office, loud speech, motorcycle	70	$6.3 * 10^4$	Loud
Heavy traffic noise, loud radio music	80	$2 * 10^5$	Very loud
Heavy goods vehicle	90	$6.3 * 10^5$	Very loud
Car horn at a distance of 5 m	100	$2 * 10^6$	Very loud
Pop group, foundry	110	$6.3 * 10^6$	Unbearable
Tunnel boring machine at a distance of 5 m	120	$2 * 10^7$	Unbearable
Jet taking off at a distance of 100 m	130	$6.3 * 10^7$	Unbearable
Jet engine at a distance of 25 m	140	$2 * 10^8$	Painful

Table 5.2: Typical sound levels

5.2.3 Sound propagation

As already described, the sound power spreads out upon an increasing surface with increasing distance, so that the resulting sound pressure level decreases at an ever-increasing distance. Additionally, the sound pressure value depends upon a specified point of the sound propagation. The following characteristics of the environment influence the sound propagation:

- Shading due to major obstacles, such as buildings, walls or land formations
- Reflections on reverberant surfaces such as rendering and glass facades of buildings, or the asphalt and stone surfaces of floors.
- Reduction of the level propagation by sound-absorbing surfaces, such as fresh snow, bark mulch or similar.
- Increase or reduction due to air humidity and air temperature or wind direction

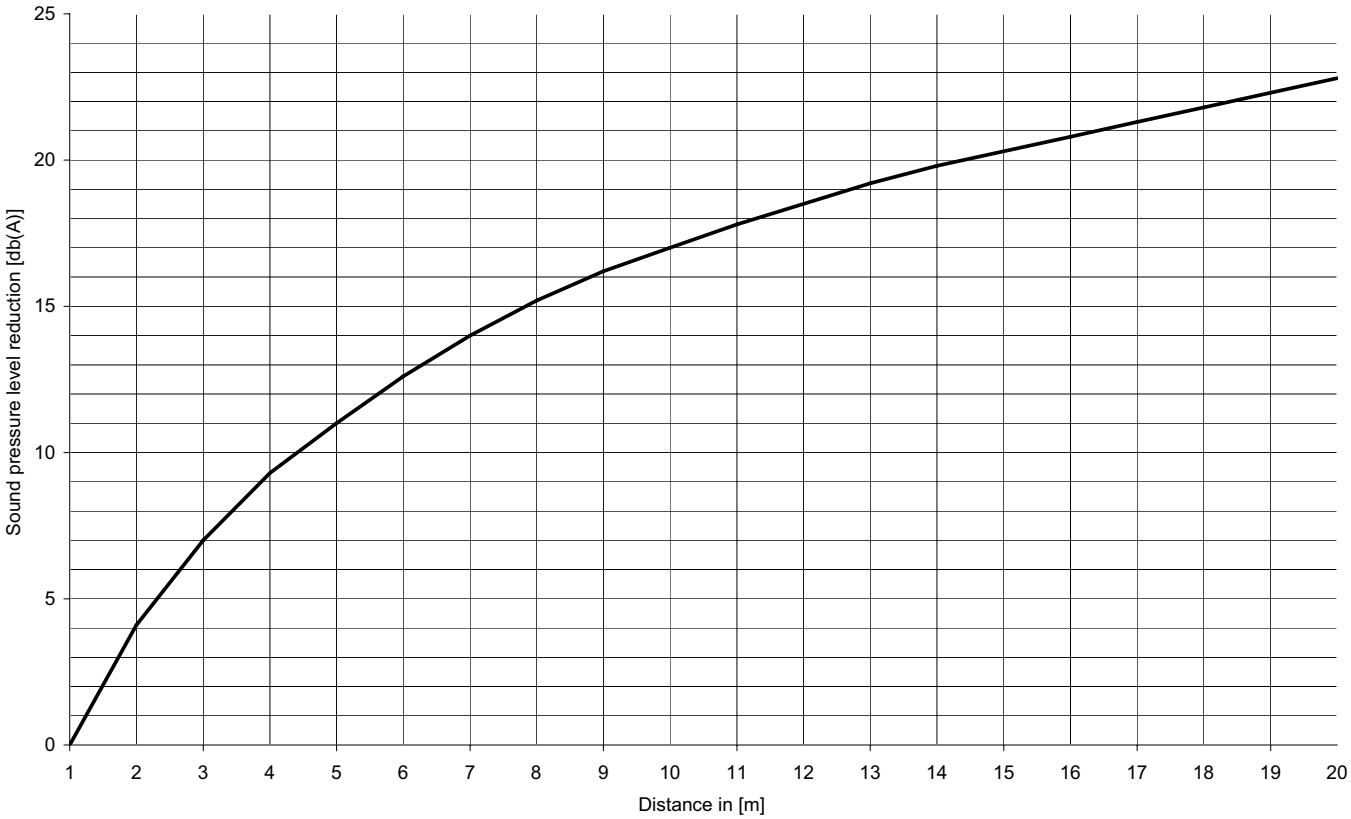


Fig. 5.3: Reduction in sound pressure level for sound propagation with a hemispherical form

For example:

Sound pressure level at a distance of 1m: 50 dB(A)

Fig. 5.3 on p. 146 shows a reduction in the sound pressure level of 11 dB(A) at a distance of 5 m.

Sound pressure level at a distance of 5 m:
50 db(A) – 11 db(A) = 39 db(A)

NOTE

Directional sound pressure levels are significant for heat pumps installed outdoors (see *Chap. 2.12 on p. 71*).

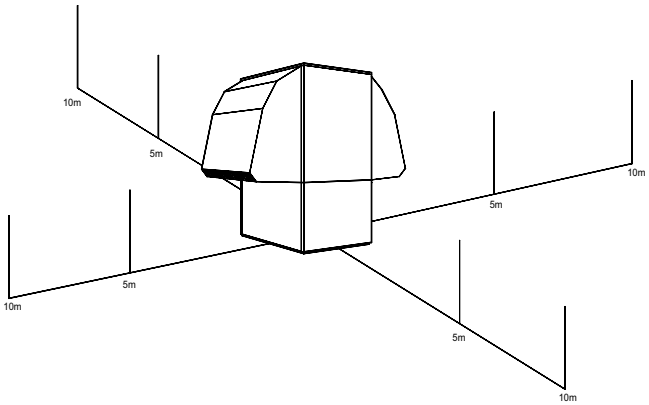


Fig. 5.4: Sound directions for air-to-water heat pumps installed outdoors

6 Domestic Hot Water Preparation and Ventilation with Heat Pumps

6.1 Domestic Hot Water Heating with the Heat Pumps for Heating Purposes

The heat pump manager regulates both space heating as well as the preparation of domestic hot water (see chapter on regulation). The system for heating domestic hot water using the heat pump should be set up parallel to the system for space heating, because a different hot water temperature is normally required for hot water preparation than for space heating. The return flow sensor should be installed in the common return flow of the heating system and the domestic hot water heating system (see chapter on integration).

6.1.1 Requirements placed on the domestic hot water cylinder

The standard continuous power ratings specified by the different cylinder manufacturers are not suitable criteria for selecting a cylinder for heat pump operation. The following criteria must be taken into consideration when selecting a cylinder: the size of the heat exchanger area, the construction and the layout of the heat exchanger in the cylinder, the continuous power rating, the flow rate and the installation position of the thermostat or sensor.

The following criteria must be taken into consideration:

- Heating up stationary hot water (covering water level losses - static state)
- The heat output of the heat pump at the maximum heat source temperature (e.g. air +35 °C) must also be transferable at a cylinder temperature of +45 °C.
- The cylinder temperature is lowered when a circulation pipe is used. The circulation pump should be time-controlled.
- It must be possible to tap the required amount of hot water even during shut-off times without the heat pump having to reheat.
- Selective reheating using a flange heater is only possible in combination with a temperature sensor.

6.1.2 Domestic hot water cylinder for heat pumps for heating purposes

The domestic hot water cylinders are used to heat the water for sanitary facilities. This is carried out indirectly using the heating water flowing in an integral coiled tubing.

Construction

The tanks are manufactured in a cylindrical design according to DIN 4753 Part 1. The heating surface is a welded, spiral-shaped pipe coil. All connections lead out from one side of the cylinder.

Corrosion protection

According to DIN 4753 Part 3, the entire interior surface of the cylinders is protected by an approved enamel coating. This enamelling is applied in a special process, and guarantees reliable corrosion protection in combination with the magnesium anode which is fitted as an accessory.

According to the specifications of the German Technical and Scientific Association for Gas and Water (DVGW), the magnesium anode should be initially inspected by after-sales service after 2 years of use and then in regular intervals. It should be replaced according to need. Depending on the quality of the domestic water (conductivity), it is advisable to have the reactive anode inspected in shorter intervals.

The anode (33 mm) should be replaced once it has reduced in size to a diameter of 10-15 mm.

Water hardness

Domestic water contains varying amounts of lime depending on its source. Hard water contains a large amount of lime. There are different water hardness levels which, in Germany, are measured in degrees of hardness (°dH).

Hardness level 1 = 0 - 7° dH (soft water)

Hardness level II = 8 - 14° dH (normal water)

Hardness level III = 15 - 21° dH (hard water)

Hardness level IV = more than 21° dH (very hard water)

“French degrees of hardness” are used in Switzerland. These correspond to

1° d.H. = 1.79° fr.H.

1° fr.H. = 0.56° d.H.

If electric flange heaters are used for general reheating to temperatures over 50 °C, we recommend the installation of a descaling system for water if the water supply has hardness level III with a hardness of > 14 °d.H. (hard and very hard water) or more.

Start-Up

Ensure that the water supply is turned on and the tank is filled before start-up. The initial filling and start-up must be carried out by a qualified specialist company. The entire system including all factory-assembled components should be inspected to ensure that everything is working properly and that there is no leakage.

Cleaning and maintenance

The mandatory cleaning intervals vary according to the water quality and the temperatures of the heating medium and the cylinder. We recommended having the tank cleaned and the system checked once a year. The glass-like surface prevents extensive build-up of lime scale and enables rapid cleaning using a powerful water jet. Large pieces of lime scale may only be broken up using a piece of wood before being rinsed away.

Sharp-edged metal objects must on no account be used for cleaning.

The operational reliability of the safety valve should be checked at regular intervals. We recommend having an annual service inspection carried out by a qualified specialist company.

Thermal insulation and covering

The thermal insulation is made of high-grade rigid polyurethane foam. The use of this material results in minimal stand-by losses.

Regulation

The cylinders are equipped as standard with a sensor with an approx. 5 m long connecting lead which is connected directly to the heat pump manager. The characteristic curve of the sensor complies with DIN 44574. The heat pump manager regulates the temperature settings and the time-controlled loading and reheating with the flange heater. Attention should be paid to the hysteresis when setting the hot water temperature. It should also be noted that the measured temperature will rise slightly because the thermal processes in the cylinder still require some time to equalize after the domestic hot water has been heated.

Regulation can also be carried out using a thermostat. The hysteresis should not exceed 2 K.

Operating conditions:

Permissible operating overpressure	
Heating water	3 bar
Domestic water	10 bar

Permissible operating temperature	
Heating water	110 °C
Domestic water	95 °C

Installation

Assembly is limited to connecting the hydraulic components of the system along with its respective safety devices and to connecting the sensor.

Accessories

Electrical flange heater for thermal reheating if required or desired.

Electrical installations should only be connected by authorised electricians according to the corresponding circuit diagram. The relevant regulations according to the Technical Specifications for Electrical Installations (TAB) and the guidelines of the Association of German Engineers (VDI) should be observed.

Installation location

The cylinder should only be installed in a room protected from frost. Installation and start-up must be carried out by an authorised specialist.

Water pipe connections

The cold water pipes are connected according to DIN 1988 and DIN 4573 Part 1 (see *Fig. 6.1 on p. 149*). All connecting pipes should be joined using pipe unions.

A circulation pipe should only be connected if the domestic water supply system is extensive because it causes high stand-by losses. If a circulation system is required, it should be fitted with an automatic device to interrupt the circulation.

All connecting pipes including fittings (with the exception of the cold water connection) must be protected against heat losses according to the German Federal Energy Efficiency Ordinance (EnEV). Poorly insulated or uninsulated connecting pipes will lead to a loss of energy which is many times greater than the energy loss of the cylinder.

A check valve should always be fitted to the heating water connection to prevent the cylinder from heating up or cooling down uncontrollably.

The air outlet pipe of the safety valve connected to the cold water pipe must always remain unblocked. The operational readiness of the safety valve should be checked at regular intervals by venting it.

Drainage

A means of draining the cylinder should be provided in the cold water connecting pipe during construction.

Pressure reducing valve

It is essential to equip the connecting pipe with a pressure reducing valve if the max. supply pressure could exceed the permissible operating overpressure of 10 bar. However, according to DIN 4709, the pipe pressure should be lowered inside buildings to a level which still permits technical operability to reduce the generation of noise. Depending on the type of building, it may then be worthwhile to install a pressure reducing valve in the cylinder inlet.

Safety valve

A tested and non-closing safety valve should be installed where the cylinder is connected to the system. No constrictions, e.g. dirt traps, should be installed between the cylinder and the safety valve.

Water should be able to flow (drip) out of the safety valve when the cylinder is being heated up to compensate for the expansion of the water and to prevent a severe build-up in pressure. The safety valve overflow pipe must flow freely into a sewage system without any constrictions. The safety valve should be mounted in an easily accessible and observable location so that it can be vented during operation of the system. A sign should be fixed on the valve itself or in its vicinity with the following inscription: “Water may be discharged from the air outlet pipe during heating! Do not close!”

Use only spring-loaded diaphragm safety valves that have been tested.

The air outlet pipe should have at least the same cross section as the safety valve outlet. If it is necessary for the air outlet circuit to have more than two bends or if it is more than 2 m in length, an air outlet pipe in the next largest nominal size should be selected.

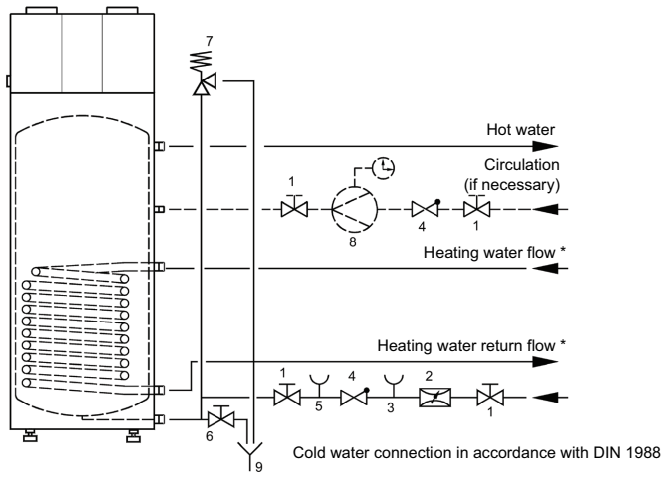
It is not permissible for the air outlet circuit to have more than three bends or to be more than 4 m in length. The cross section of the outlet pipe located downstream from the collecting hopper must be at least twice the size of the cross section of the valve inlet. The safety valve must be adjusted so that the permissible operating overpressure of 10 bar is not exceeded.

Check valve, test valve

A check vale (return flow inhibitor) must be installed to prevent the heated water from flowing back into the cold water pipe. Its function can be tested by closing the first shutoff valve in the direction of flow and opening the test valve. Only the water contained in the short piece of pipe should be discharged.

Shutoff valves

As illustrated in *Fig. 6.1 on p. 149*, shutoff valves are to be installed on the cylinder in both the cold and hot water pipes as well as in the heating water flow and return flow.



Legend

1) Shutoff valve
2) Pressure reducing valve
3) Test valve
4) Return flow inhibitor
5) Pressure gauge connecting stubs
6) Drain valve
7) Safety valve
8) Circulation pump
9) Outlet

Fig. 6.1: Water pipe connections

Pressure drops

The pressure drops of the internal heat exchanger should be taken into consideration when dimensioning the loading pump for the domestic hot water cylinder.

Temperature settings for domestic hot water preparation with the heat pump for heating purposes

Low-temperature heat pumps have a max. flow temperature of 55 °C. This temperature must not be exceeded during the preparation of domestic hot water in order to prevent the heat pump from being switched off by the high pressure controller.

The temperature setting of the controller should, therefore, be below the maximum attainable cylinder temperature.

The maximum attainable cylinder temperature is dependent on the output of the installed heat pump and the amount of heating water flowing through the heat exchanger. The maximum attainable hot water temperature for heat pumps for heating purposes is calculated according to *Chap. 6.1.3 on p. 149*. It should also be taken into consideration that the thermal energy stored in the heat exchanger will cause a further reheating of approx. 3 K. The set temperature can be 2 to 3 K lower than the desired hot water temperature when preparing domestic hot water with the heat pump.

6.1.3 Attainable cylinder temperatures

The maximum hot water temperature which can be attained using a heat pump is dependent on:

- The heat output of the heat pump
- The heat exchanger surface area in the cylinder and
- The discharge rate (volume flow) of the circulating pump.

The domestic hot water cylinder must be selected on the basis of the max. heat output of the heat pump (summer operation) and the desired cylinder temperature (e.g. 45 °C).

The pressure drops of the cylinder should be taken into consideration when dimensioning the hot water circulating pump.

The heat supplied by the heat pump cannot be transferred if the maximum hot water temperature (HP maximum) to be attained using a heat pump is set too high on the controller (also see the chapter Control and Regulation).

When the maximum permissible pressure in the refrigerating circuit is reached, the heat pump manager's high pressure safety program switches off the heat pump automatically, blocking hot water heating for 2 hours.

If the domesctic hot water cylinder is equipped with a sensor, the set hot water temperature (HP maximum new = current actual temperature in the domestic hot water cylinder – 1 K) is automatically corrected.

If higher hot water temperatures are required, the water can be reheated electrically according to need (flange heater in the domestic hot water cylinder).

NOTE

The hot water temperature (HP maximum) should be set approx. 10 K under the maximum flow temperature of the heat pump.
domestic hot water preparation for mono energy heat pump systems is carried out exclusively by the flange heater whenever the heat pump can no longer meet the heating requirements of the building on its own.

For example:

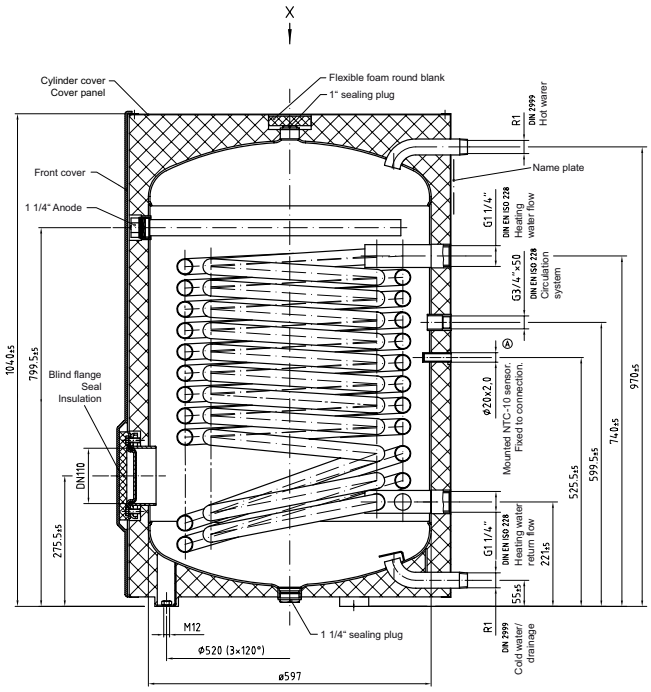
Heat pump with a maximum heat output of 14 kW with a maximum flow temperature of 55 °C

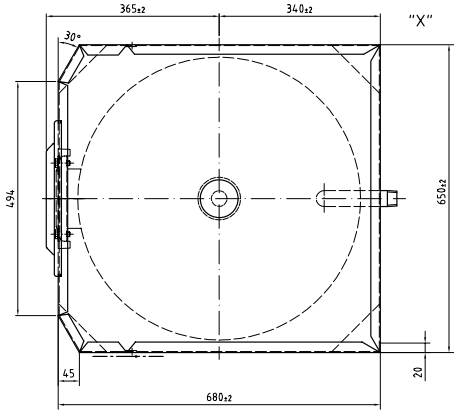
Domestic hot water cylinder - 400 litres

Volume flow of the hot water loading pump: 2,0 m^3/h

Based on *Chap. 6.1.7 on p. 153* the result is a
hot water temperature of: ~47 °C

6.1.4 Device information for hot water cylinder design WWSP 229E

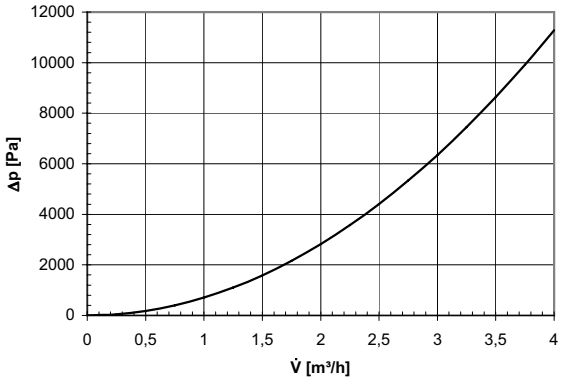




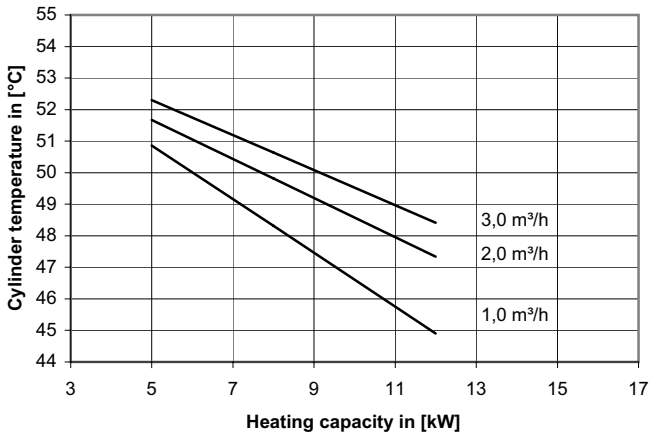
Technical Data	
Nominal volume	200 l
Usable capacity	206 l
Heat exchange surface area	2.96 m^2
Height	1040 mm
Width	650 mm
Depth	680 mm
Diameter	
Max. operating temperature, heating water	110 °C
Max. operating pressure, heating water	10 bar
Max. operating temperature, hot water	95 °C
Max. operating pressure, hot water	10 bar
Packed cylinder weight	110 kg

Connections	
Cold water	1“ external thread
Domestic hot water	1“ external thread
Circulation	3/4“ internal thread
Heating water flow	1 1/4“ internal thread
Heating water return flow	1 1/4“ internal thread
Flange	TK150/DN110
Anode diameter	33 mm
Anode length	530 mm
Anode connection thread	1 1/4“

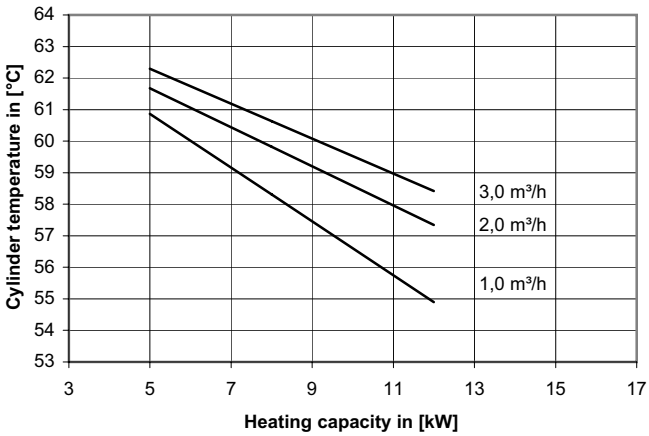
Pressure drop, hot water cylinder:
t_{water} = 20 °C, p_{water} = 2 bar



Attainable cylinder temperatures at 55 °C flow temperature

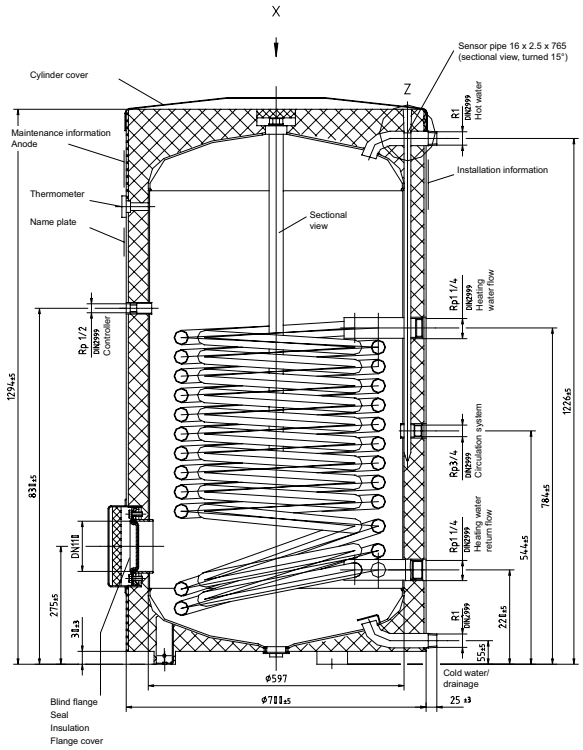


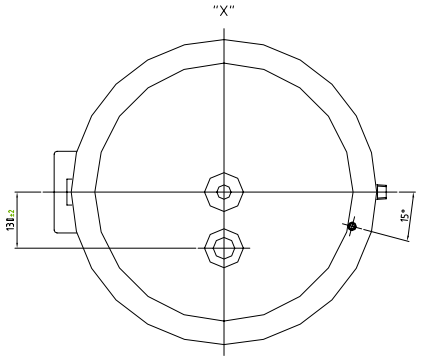
Attainable cylinder temperatures at 65 °C flow temperature



Depending upon the heat pump manager available in the heat pump system, various hot water sensors must be installed.
WPM 2006 with integrated display and round buttons => standardised NTC-2 sensor
WPM 2007 with removable control panel and rectangular buttons => NTC-10 sensor

6.1.5 Device information for hot water cylinder WWSP 332

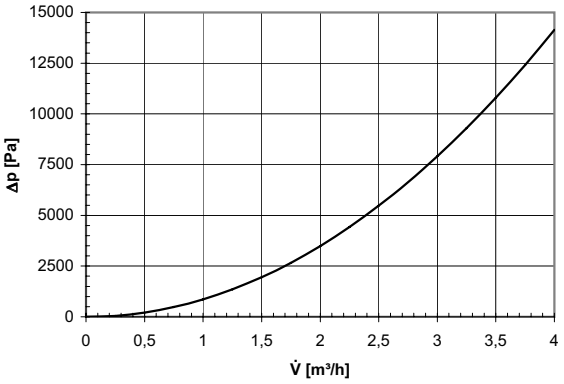




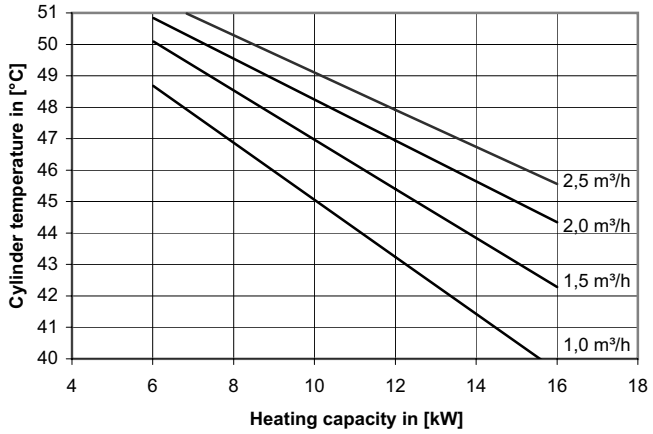
Technical Data	
Nominal volume	300 l
Usable capacity	277 l
Heat exchange surface area	3.15 m^2
Height	1294 mm
Width	
Depth	
Diameter	700 mm
Standard sensor immersion depth	65 - 70 cm
Max. operating temperature, heating water	110 °C
Max. operating pressure, heating water	10 bar
Max. operating temperature, hot water	95 °C
Max. operating pressure, hot water	10 bar
Packed cylinder weight	130 kg

Connections	
Cold water	1“ external thread
Domestic hot water	1“ external thread
Circulation	3/4“ internal thread
Heating water flow	1 1/4“ internal thread
Heating water return flow	1 1/4“ internal thread
Flange	TK150/DN110
Anode diameter	33 mm
Anode length	625 mm
Anode connection thread	1 1/4“

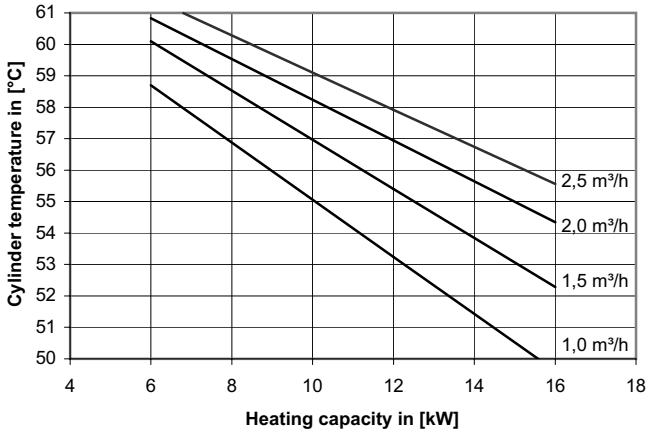
Pressure drop, hot water cylinder: t_{water} = 20 °C, p_{water} = 2 bar



Attainable cylinder temperatures at 55 °C flow temperature

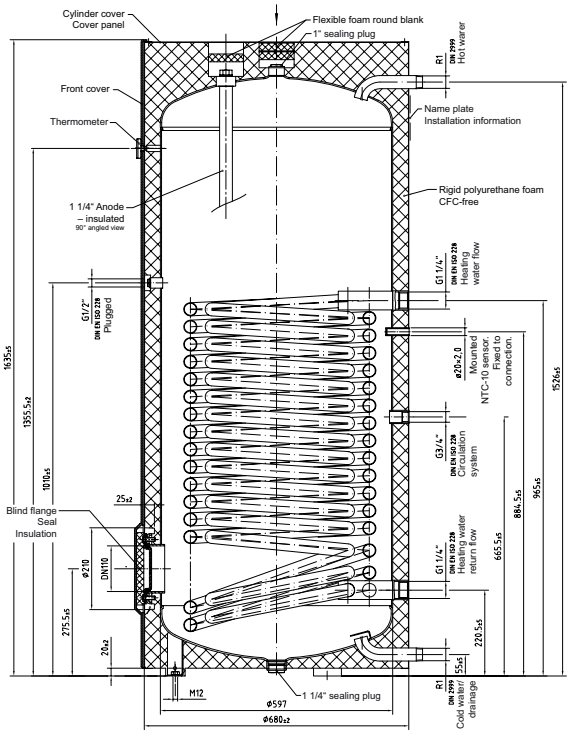


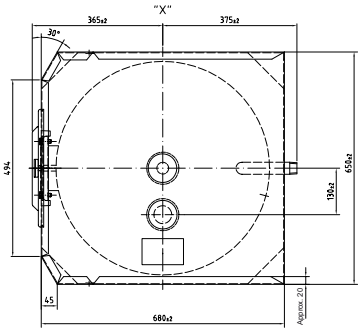
Attainable cylinder temperatures at 65 °C flow temperature



Depending upon the heat pump manager available in the heat pump system, various hot water sensors must be installed.
WPM 2006 with integrated display and round buttons => standardised NTC-2 sensor
WPM 2007 with removable control panel and rectangular buttons =>NTC-10 sensor

6.1.6 Device information for hot water cylinder design WWSP 442E

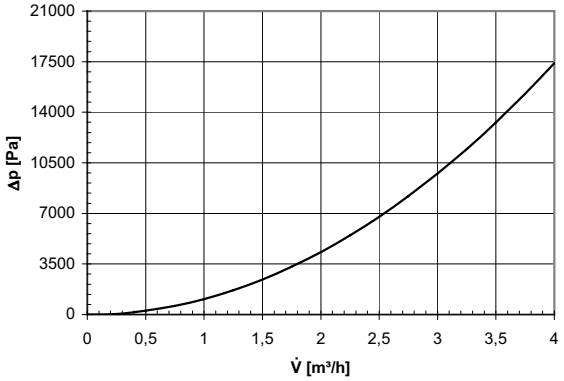




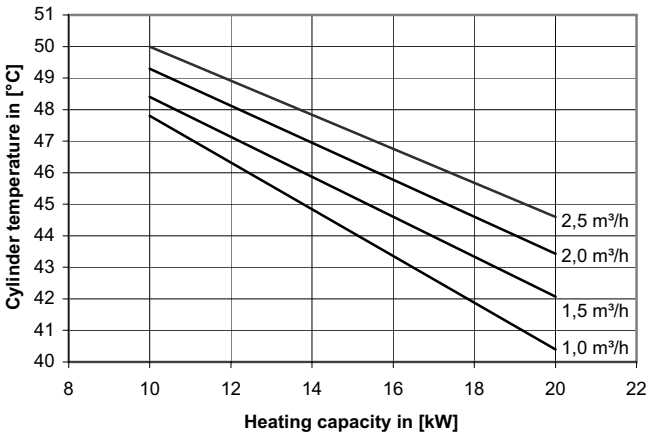
Technical Data	
Nominal volume	400 l
Usable capacity	353 l
Heat exchange surface area	4.20 m^2
Height	1630 mm
Width	650 mm
Depth	680 mm
Diameter	
Max. operating temperature, heating water	110 °C
Max. operating pressure, heating water	10 bar
Max. operating temperature, hot water	95 °C
Max. operating pressure, hot water	10 bar
Packed cylinder weight	187 kg

Connections	
Cold water	1“ external thread
Domestic hot water	1“ external thread
Circulation	3/4“ internal thread
Heating water flow	1 1/4“ internal thread
Heating water return flow	1 1/4“ internal thread
Flange	TK150/DN110
Anode diameter	33 mm
Anode length	850 mm
Anode connection thread	1 1/4“

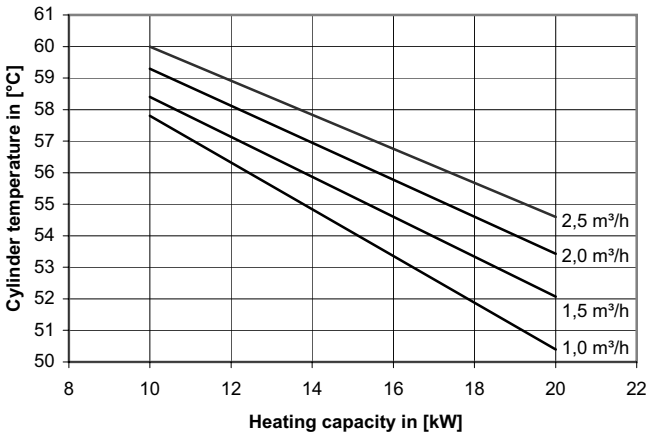
Pressure drop, hot water cylinder:
t_{water} = 20 °C, p_{water} = 2 bar



Attainable cylinder temperatures at 55 °C flow temperature

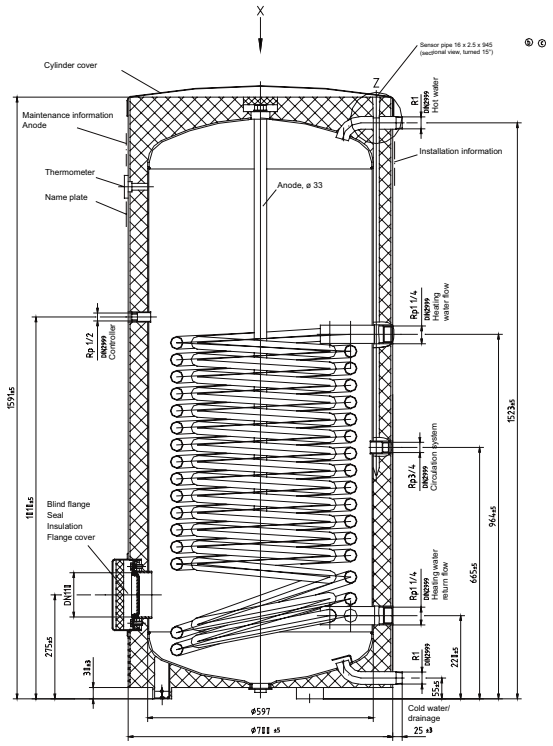


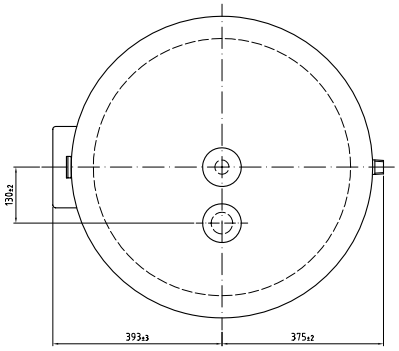
Attainable cylinder temperatures at 65 °C flow temperature



Depending upon the heat pump manager available in the heat pump system, various hot water sensors must be installed.
WPM 2006 with integrated display and round buttons => standardised NTC-2 sensor
WPM 2007 with removable control panel and rectangular buttons =>NTC-10 sensor

6.1.7 Device information for hot water cylinder WWSP 880

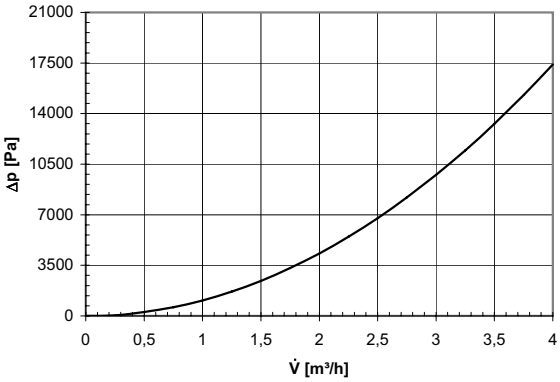




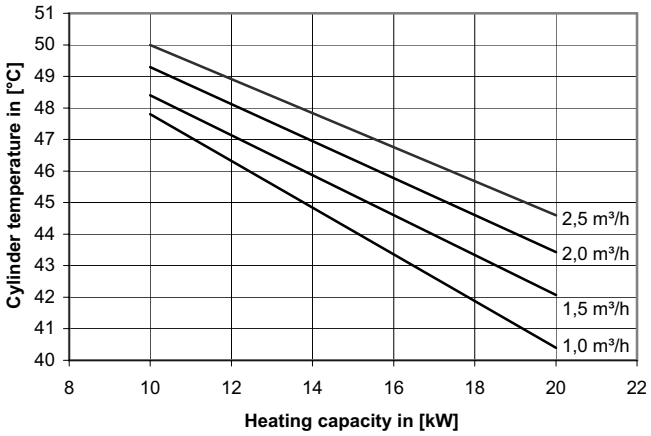
Technical Data	
Nominal volume	400 l
Usable capacity	353 l
Heat exchange surface area	4.20 m^2
Height	1591 mm
Width	
Depth	
Diameter	700 mm
Standard sensor immersion depth	65 - 70 cm
Max. operating temperature, heating water	110 °C
Max. operating pressure, heating water	10 bar
Max. operating temperature, hot water	95 °C
Max. operating pressure, hot water	10 bar
Packed cylinder weight	145 kg

Connections	
Cold water	1“ external thread
Domestic hot water	1“ external thread
Circulation	3/4“ internal thread
Heating water flow	1 1/4“ internal thread
Heating water return flow	1 1/4“ internal thread
Flange	TK150/DN110
Anode diameter	33 mm
Anode length	850 mm
Anode connection thread	1 1/4“

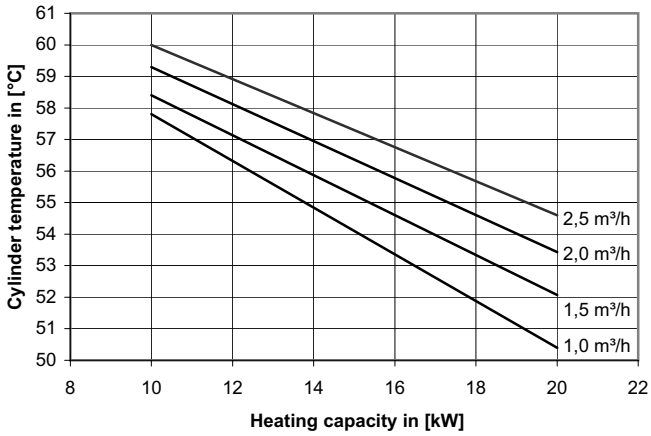
Pressure drop, hot water cylinder: t_{water} = 20 °C, p_{water} = 2 bar



Attainable cylinder temperatures at 55 °C flow temperature

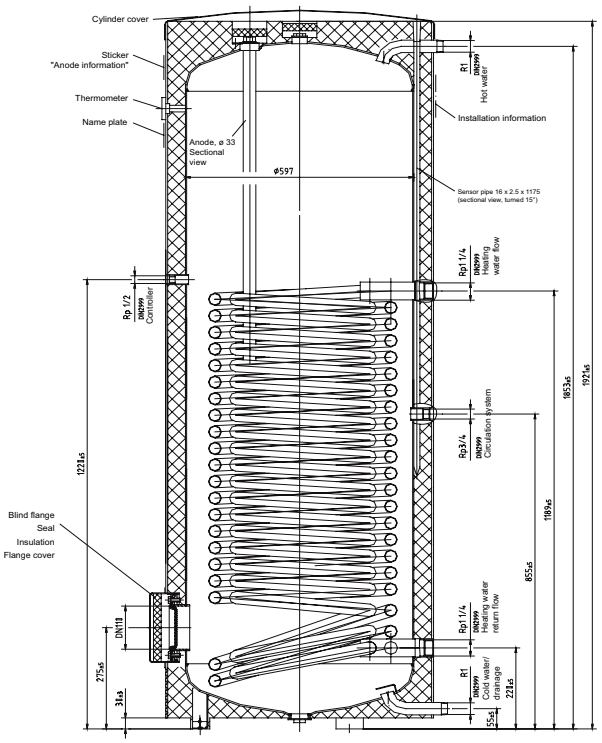


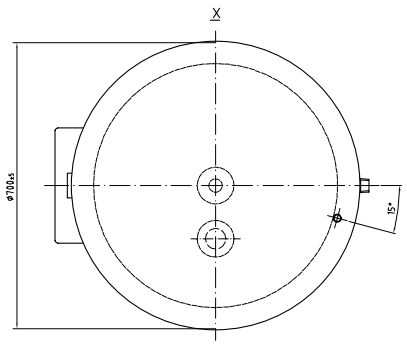
Attainable cylinder temperatures at 65 °C flow temperature



Depending upon the heat pump manager available in the heat pump system, various hot water sensors must be installed.
WPM 2006 with integrated display and round buttons => standardised NTC-2 sensor
WPM 2007 with removable control panel and rectangular buttons =>NTC-10 sensor

6.1.8 Device information for hot water cylinder WWSP 900

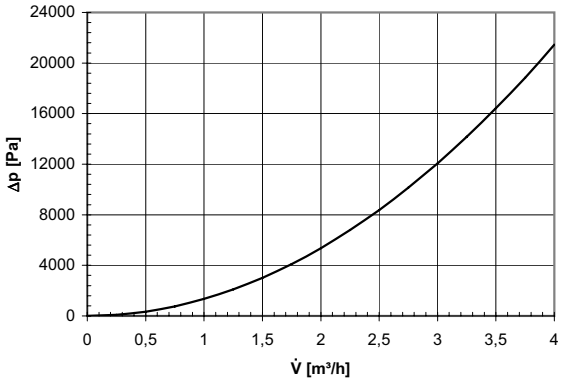




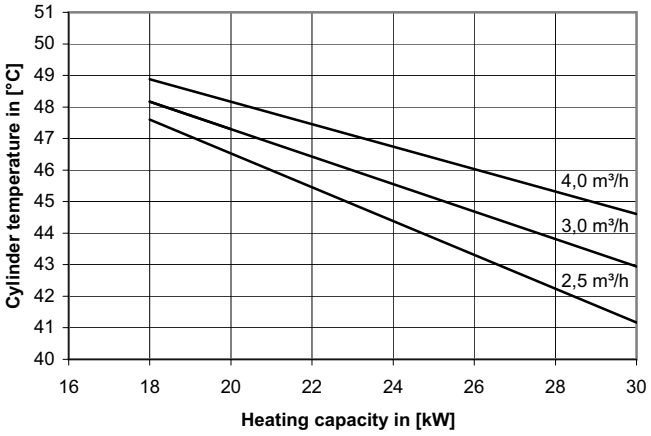
Technical Data	
Nominal volume	500 l
Usable capacity	433 l
Heat exchange surface area	5.65 m²
Height	1920 mm
Width	
Depth	
Diameter	700 mm
Standard sensor immersion depth	65 - 70 cm
Max. operating temperature, heating water	110 °C
Max. operating pressure, heating water	10 bar
Max. operating temperature, hot water	95 °C
Max. operating pressure, hot water	10 bar
Packed cylinder weight	180 kg

Connections	
Cold water	1“ external thread
Domestic hot water	1“ external thread
Circulation	3/4“ internal thread
Heating water flow	1 1/4“ internal thread
Heating water return flow	1 1/4“ internal thread
Flange	TK150/DN110
Anode diameter	33 mm
Anode length	1100 mm
Anode connection thread	1 1/4“

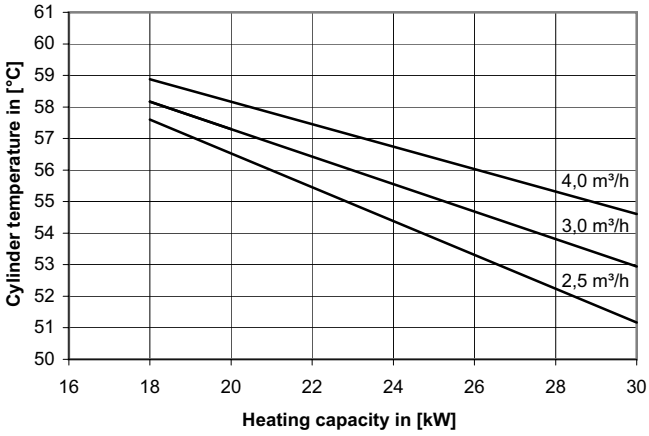
Pressure drop, hot water cylinder:
t_{water} = 20 °C, p_{water} = 2 bar



Attainable cylinder temperatures at 55 °C flow temperature

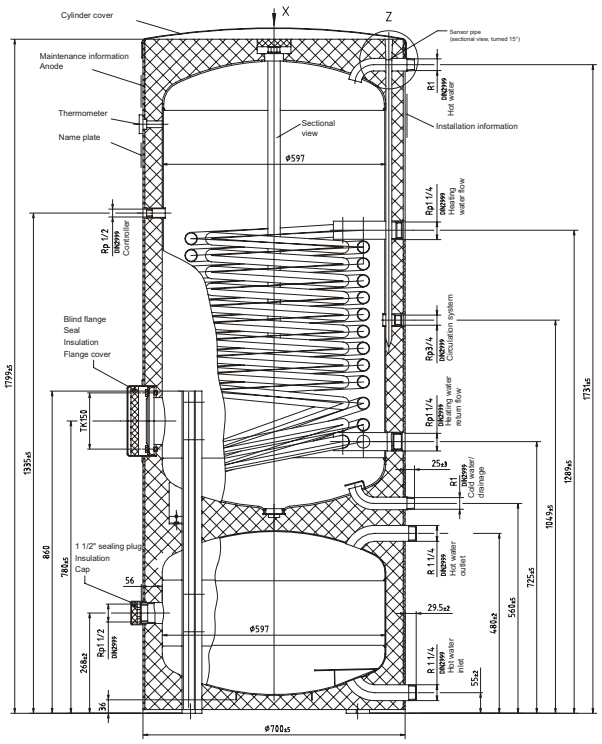


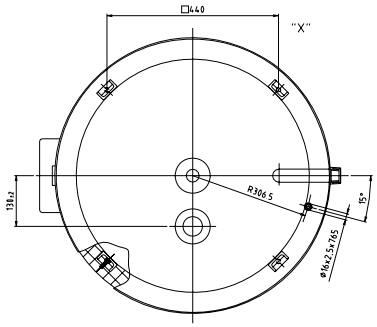
Attainable cylinder temperatures at 65 °C flow temperature



Depending upon the heat pump manager available in the heat pump system, various hot water sensors must be installed.
WPM 2006 with integrated display and round buttons => standardised NTC-2 sensor
WPM 2007 with removable control panel and rectangular buttons =>NTC-10 sensor

6.1.9 Device information for combination tank PWS 332

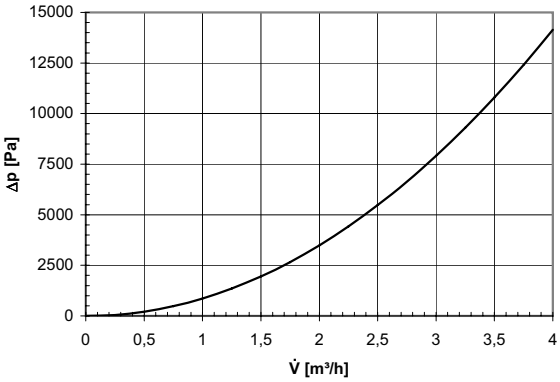




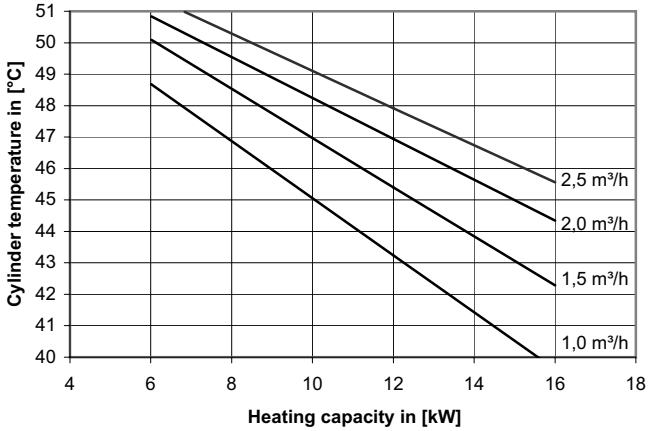
Technical Data	
Nominal volume	300 l
Usable capacity	277 l
Heat exchange surface area	3.15 m^2
Height	1800 mm
Width	
Depth	
Diameter	700 mm
Standard sensor immersion depth	65 - 70 cm
Max. operating temperature, heating water	110 °C
Max. operating pressure, heating water	10 bar
Max. operating temperature, hot water	95 °C
Max. operating pressure, hot water	10 bar
Packed cylinder weight	180 kg

Connections	
Cold water	1“ external thread
Domestic hot water	1“ external thread
Circulation	3/4“ internal thread
Heating water flow	1 1/4“ internal thread
Heating water return flow	1 1/4“ internal thread
Flange	TK150/DN110
Anode diameter	33 mm
Anode length	690 mm
Anode connection thread	1 1/4“

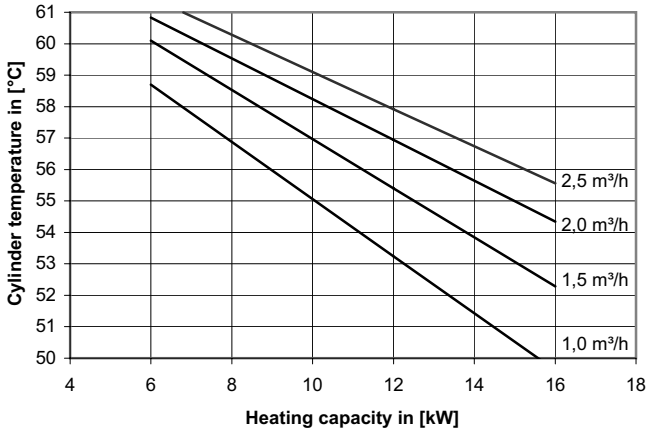
Pressure drop, hot water cylinder: t_{water} = 20 °C, p_{water} = 2 bar



Attainable cylinder temperatures at 55 °C flow temperature

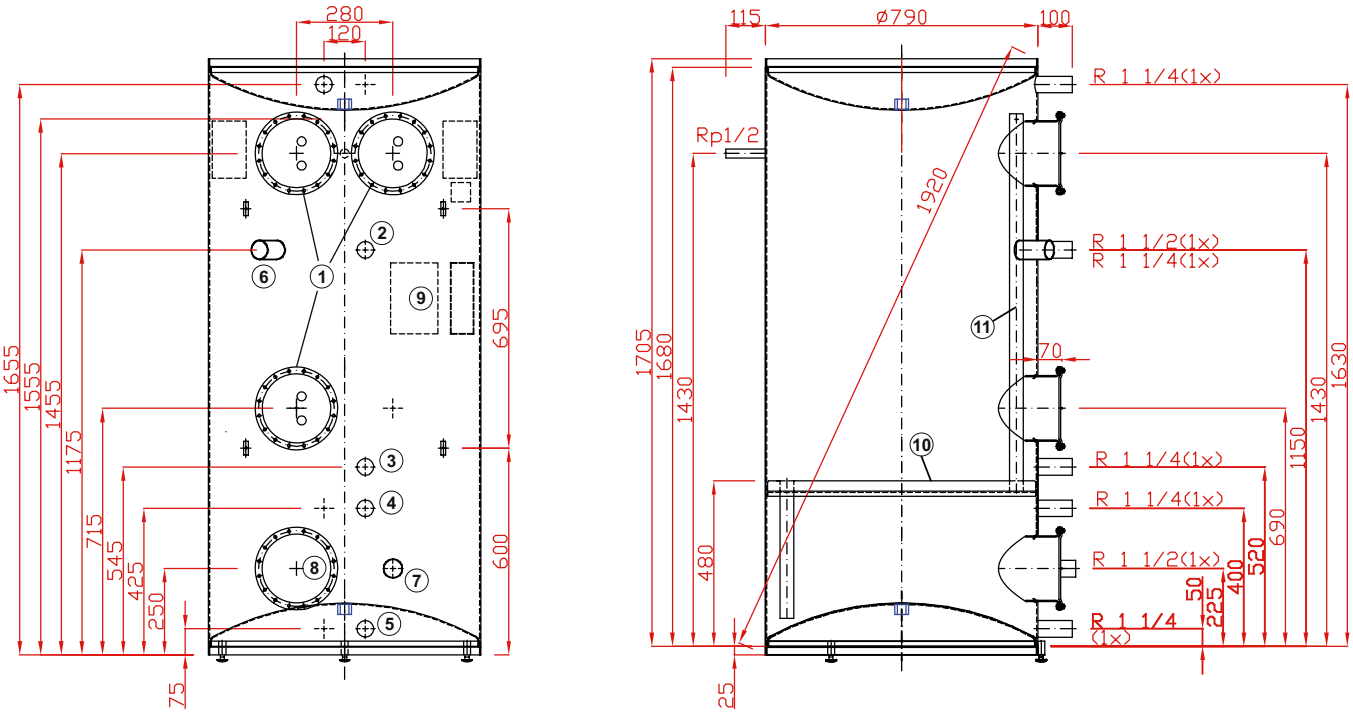


Attainable cylinder temperatures at 65 °C flow temperature



Depending upon the heat pump manager available in the heat pump system, various hot water sensors must be installed.
WPM 2006 with integrated display and round buttons => standardised NTC-2 sensor
WPM 2007 with removable control panel and rectangular buttons =>NTC-10 sensor

6.1.10 Device information for combination tank PWD 750



1	Finned tube heat exchanger
2	Flow for domestic hot water preparation
3	Return flow for domestic hot water preparation
4	Heating water outlet
5	Heating water inlet
6	immersion heater for hot water buffer
7	Immersion heater for heating buffer
8	Flange connection for optimal RWT 750 solar heat exchanger
9	Temperature sensor for hot water (R3)

Buffer tank temperature[1]	Pouring output during shower operation[2]
53 °C	280 l
48 °C	190 l

1. Initial temperature above the circular plate
2. The volume of hot water refers to a mean hot water temperature of 40 °C with a flow of 15 l/min, cold water inlet temperature of 10 °C. As opposed to bath tub operation, during shower operation the outlet temperature does not fall below 40 °C at the hot water extraction point.

Fig. 6.2: PWD 750 combination tank with domestic hot water preparation acc. to the flow principle

6.1.11 Country-specific requirements

Germany: German Technical and Scientific Association for Gas and Water (DVGW) worksheet W 551

The DVGW worksheet W 551 describes measures for reducing the growth of legionella bacteria in domestic water systems. A distinction is made between **small systems** (detached and semi-detached houses) and **large systems** (all other systems with cylinder volumes larger than 400 litres and pipe volumes larger than 3 l between the cylinders and the extraction points).

It is recommended that the temperature controller for domestic hot water preparation is set to 60 °C for small systems. Operating temperatures under 50 °C should always be avoided.

The water at the hot water outlet, for example, must be heated to a minimum of 60 °C for large systems.

Pipe lengths with a 3 l volume	
Copper pipe ∅ x mm	**Pipe length / m**
10 x 1.0	60.0
12 x 1.0	38.0
15 x 1.0	22.5
18 x 1.0	14.9
22 x 1.0	9.5
28 x 1.0	5.7
28 x 1.5	6.1

Switzerland: Swiss Technical and Scientific Association for Gas and Water (SVGW) data sheet TPW: Legionella bacteria in domestic water installations – What should be kept in mind?

This data sheet discusses where problems with legionella bacteria in domestic water could arise and the available options for effectively reducing the risk of infection.

NOTE

Installation of a flange heater is generally recommended to enable heating to temperatures of over 60 °C. Electric reheating can be time-controlled by the controller according to the application and/or customer requirements.

6.1.12 Connecting more than one domestic hot water cylinder in a single circuit

If water consumption is very high or if heat pumps with an output of more than approx. 28 kW are implemented for hot water operation, the heat exchanger area required to ensure that adequate hot water temperatures are maintained can be created by connecting the heat exchangers of several domestic hot water cylinders in parallel or in series. (Refer to German Technical and Scientific Association for Gas and Water - work sheet W551)

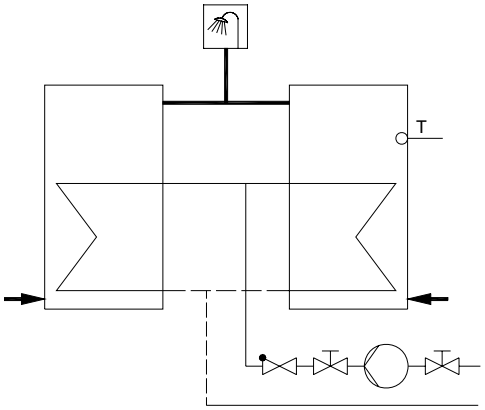


Fig. 6.3: Connecting domestic hot water cylinders in parallel

Connecting more than one domestic hot water in parallel is particularly suitable where large quantities of water are tapped. This layout is only possible when identically constructed domestic hot water cylinders are used. When connecting the heat exchangers with the hot water circuit, the pipes from the tee joint onwards leading to each cylinder should have the same pipe diameter and the same length. This ensures that the hot water volume flow is divided between the two systems with the same drop in pressure. (see *Fig. 6.3 on p. 157*)

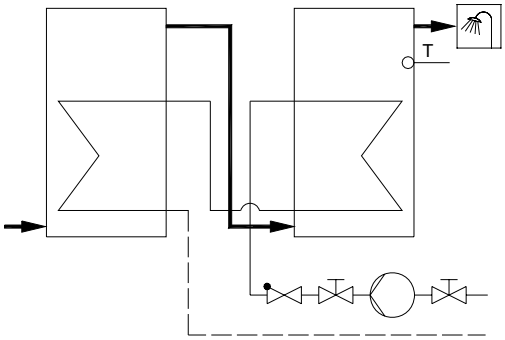


Fig. 6.4: Connecting domestic hot water cylinders in series

Connecting domestic hot water cylinders in series is the preferred installation set-up. It should be taken into consideration during the integration that the heating water must first pass through the cylinder from which the domestic water is drawn. (see *Fig. 6.4 on p. 157*)

6.2 Domestic Hot Water Heating with Domestic Hot Water Heat Pumps

The domestic hot water heat pump is a ready-to-use heating device that is exclusively used to heat water for domestic use and drinking water. Basically, it consists of the casing, the components for the refrigerant, air and water circuits as well as all of the control-, regulation and monitoring devices required for automatic operation. With the help of electrical energy, the domestic hot water heat pump uses the heat stored in the sucked in air for domestic hot water heating.

The devices are equipped as standard with an electric heating element (1.5 kW).

The electric heating element fulfils four functions:

- **Supplementary heating:** The heating-up period is approx. halved by switching on the heating element in addition to the heat pump.
- **Antifreeze:** The electric heating element switches on automatically whenever the temperature of the intake air sinks below 8° C.
- **Emergency heating:** The domestic hot water supply is maintained by the heating element when the heat pump is out of order.
- **Higher water temperature:** If the required hot water temperature is higher than the temperature achievable by the heat pump (approx. 60 °C), it can be raised to a max. of 85 °C (factory setting 65 °C) by means of the heating element.

NOTE

Whenever the hot water temperatures exceed 60 °C, the heat pump is switched off and the domestic hot water is heated solely by the heating element.

The water installations for the heating system are to be carried out according to DIN 1988.

The condensate hose is attached to the rear of the device. It should be routed so that the condensate produced can flow away without obstruction. The condensate should be drained into a U bend.

The domestic hot water heat pump is wired ready for use: only the mains plug needs to be plugged into a socket in the building.

NOTE

Connection to a heat pump meter is possible if the domestic hot water heat pump is installed permanently.

Regulation and control devices

The domestic hot water heat pump is equipped with the following regulation and control components:

The temperature controller for the heating element regulates the hot water temperature when the water is being heated by the heating element. The factory default setting is 65 °C.

Temperature control in the water circuit and the regulation for compressor operation is carried out by the temperature controller. This regulates the water temperature on the basis of the setpoint. The desired temperature can be set by means of a rotary knob on the control panel.

The air temperature thermostat is mounted on the control room panel. Whenever the set switching value (8 °C) is undershot, domestic hot water heating is automatically switched from heat pump operation to heating element operation.

The thermometer sensor measures the hot water temperature in the upper part of the domestic hot water cylinder.

In the case of domestic hot water heat pumps equipped with an additional internal heat exchanger, a relay with a floating contact automatically switches on a second heat generator according to need.

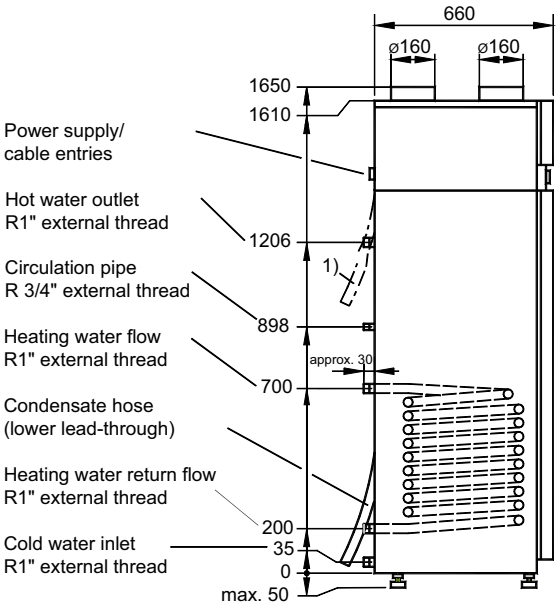


Fig. 6.5: Connections and dimensions of the domestic hot water heat pump AWP 30HLW equipped with an auxiliary internal heat exchanger
[1)] Alternative routing of the condensate hose

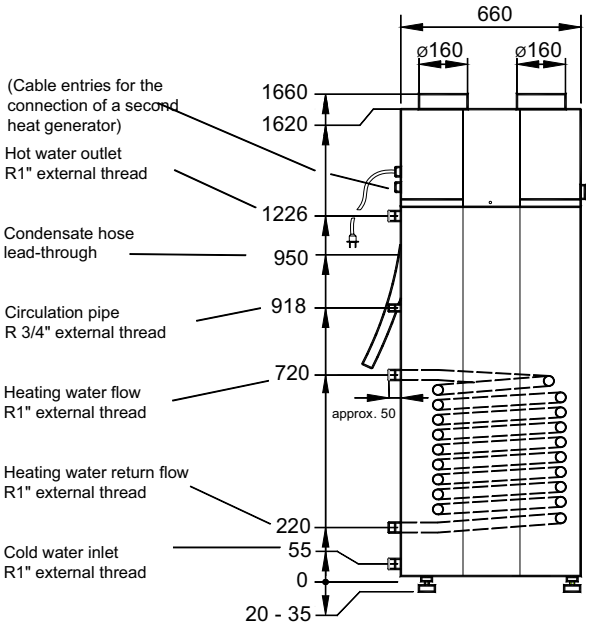


Fig. 6.6: Connections and dimensions of the domestic hot water heat pumps BWP 30HLW equipped with an auxiliary internal heat exchanger

Set-up

The domestic hot water heat pump must be installed in a frost-free room. The installation location should fulfil the following prerequisites:

- Have a room temperature between 8 °C and 35 °C (for heat pump operation)
- Be thermally well insulated from the neighbouring rooms (recommended)
- Have a drainage available for the condensate produced
- Have an environment that is not excessively dusty
- Have a load-bearing floor (approx. 500 kg)

To ensure smooth operation and facilitate repair and maintenance work, there should be minimum clearances of 0.6 m on all sides of the device as well as a minimum room height of approx. 2.50 m when implementing a “free venting” installation setup (without air ducts/hoses or bends).

At least one air circuit bend (90° NW 160) must be installed on the blow-out side for effective operation in rooms with lower ceilings.

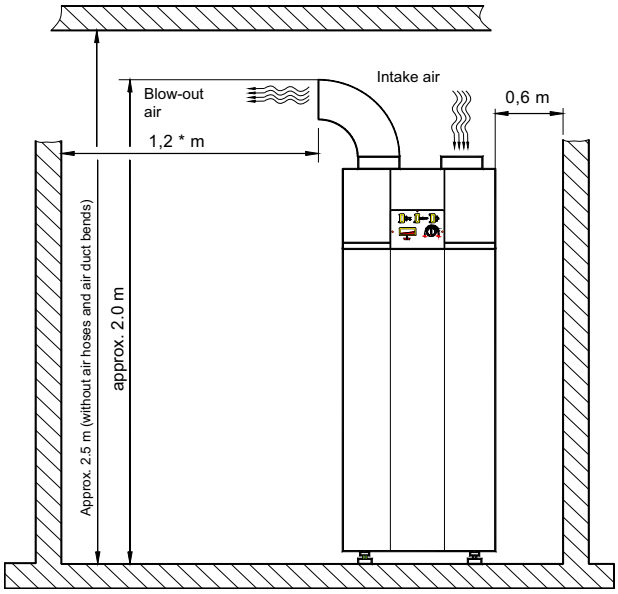


Fig. 6.7: Installation requirements for freely drawing in and blowing out process air.
*) Minimum clearance between the exhaust air outlet in the air circuit bend and the wall is 1.2 m

Air ducts/air hoses can be optionally connected on both the air inlet and the air outlet side. These should not exceed a total length of 10 m. Flexible, thermally-insulated and sound-insulated DN 160 air hoses are available as accessories.

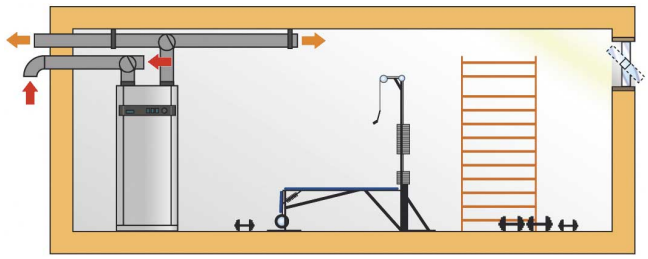
NOTE

The condensate produced by the heat pump is lime-free and can be used for steam irons or air humidifiers.

6.2.1 Air circulation variations

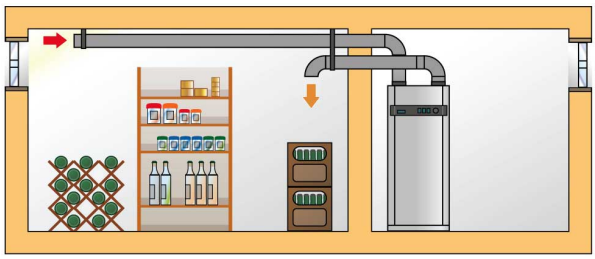
Variable switching of the intake air

A pipe duct system with integrated bypass flap allows the variable use of the heat extracted from outdoor or indoor air for domestic hot water preparation (lower operating limit: + 8 °C).



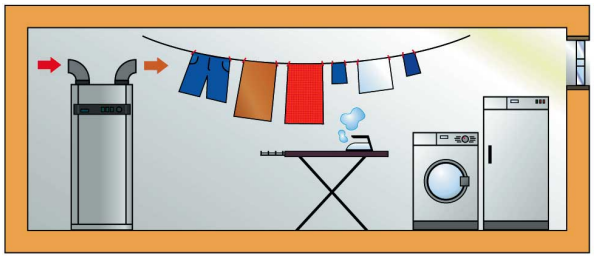
Cooling in recirculating air operation

Indoor air is removed by suction from storage rooms or wine cellars, and is then cooled and dehumidified in the domestic hot water heat pump and blown out again. Suitable locations for installation include hobby rooms, furnace rooms and laundry rooms. The air ducting in the heated section of the system should be insulated with water-proof insulation to prevent the formation of condensate.



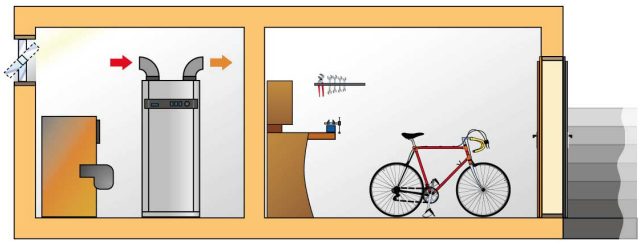
Dehumidifying in recirculating air operation

Dehumidified air in laundry rooms can be used to dry laundry and prevents damage caused by dampness.



Waste heat is useful heat

Our standard heat exchangers (AWP 30HLW and BWP 30HLW only) for domestic hot water heat pumps enable direct connection of a second heat generator, i.e. a solar energy system or a boiler.



6.2.2 Device information for domestic hot water heat pumps

Device information for domestic hot water heat pumps					
1	**Type and order code**		BWP 30H	BWP 30HLW	AWP 30HLW
2	**Design**		Without additional internal heat exchanger	With additional internal heat exchanger	With additional internal heat exchanger
2.1	**Casing**		Foil cladding	Foil cladding	Painted sheet steel
2.2	**Colour**		White, similar to RAL 9003	White, similar to RAL 9003	White, similar to RAL 9003
2.3	**Nominal cylinder volume**	**l**	300	290	290
2.4	**Cylinder material**		Enamelled steel according to DIN 4753	Enamelled steel according to DIN 4753	Enamelled steel according to DIN 4753
2.5	**Nominal cylinder pressure**	**bar**	10	10	10
3	**Design**				
3.1	**Dimensions height (max.) x cross-section (max.)**	**mm**	1695 x 700	1695 x 700	
3.2	**Dimensions W x H x D (overall)**	**mm**			660 x 700 x 1700
3.3	**Weight**	**kg**	Approx. 110	Approx. 125	Approx. 175
3.4	**Electrical connection (plug-in - lead length approx. 2.7 m)**		1/N/PE ~ 230 V, 50 Hz	1/N/PE ~ 230 V, 50 Hz	1/N/PE ~ 230 V, 50 Hz
3.5	**Fuse**	**A**	16	16	16
3.6	**Refrigerant / total filling weight**	**- / kg**	R134a / 1.0	R134a / 1.0	R134a / 1.0
4	**Operating conditions**				
4.1	**Selectable water temperature (heat pump operation $^{\pm 1.5\ K}$)**	**°C**	23 to 60	23 to 60	23 to 60
4.2	**Air temperature operating range of heat pumps [1]**	**°C**	8 to 35	8 to 35	8 to 35
4.3	**Sound pressure level [2]**	**dB(A)**	53	53	53
4.4	**Air flow during heating-only heat pump operation**	**m^3/h**	450	450	450
4.5	**External compression**	**Pa**	100	100	100
4.6	**Maximum length of pipe that can be used for the air duct**	**m**	10	10	10
5	**Connections**				
5.1	**Diameter of the air duct connection (inlet/outlet)**	**mm**	160	160	160
5.2	**Transfer area of the internal tube heat exchanger**	**m^2**	-	1.45	1.45
5.3	**Sensor pipe $D_{internal}$ (for sensor – heat exchanger operation)**	**mm**	-	12	12
5.4	**Water connections - cold water / hot water**		R 1“	R 1“	R 1“
5.5	**Circulation pipe**		R 3/4"	R 3/4"	R 3/4"
5.6	**Heat exchanger flow / return flow**		-	R 1“	R 1“
6	**Performance data**				
6.1	**Power consumption supplementary electrical heating**	**W**	1500	1500	
6.2	**Mean power consumption [3] at 60 °C**	**W**	615	615	615
6.3	**Mean heat output [4] at 45 °C**	**W**	1870	1870	1870
6.4	**$COP_{(t)}$ according to EN 255 at 45 °C**	**-**	3.5	3.5	3.5
6.5	**Stand-by energy consumption at 45 °C/24h**	**(W)**	47	47	47
6.6	**Max. mixed water volume at 40 °C $V_{max.}$**	**l**	300	290	290
6.7	**Heating-up period from 15 °C to 60 °C t_h**	**h**	9.1	9.1	9.1

1. Temperatures below 8 °C (+/- 1.5 °C) will cause the heating element to switch on and the heat pump module to switch off automatically; the dead-band value of the controller is 3 K
2. At a distance of 1 m (free-standing installation without inlet and outlet ducting or without 90° pipe bends on the outlet side)
3. Heating up of the nominal volume from 15 °C to 60 °C at an air inlet temperature of 15 °C and 70 % relat. humidity
4. Heating up of the nominal volume from 15 °C to 45 °C at an air inlet temperature of 15 °C and 70 % relat. humidity

6.3 Domestic Ventilation Units for DHW Preparation

New types of materials and construction materials have made it possible to significantly reduce heating energy consumption. Optimum thermal insulation combined with a good seal on the outer shell of the building ensures that almost no heat is lost to the outside air. On the other hand, extremely well sealed windows prevent the necessary exchange of air in both old buildings and new buildings. This effect leads to contamination of the indoor air. Water vapour and pollutants accumulate in the air and must be actively discharged.

How to ventilate correctly

Probably the simplest way to ventilate a room is to refresh the air by opening a window. Ventilation at regular intervals by briefly opening the windows is recommended to maintain an acceptable living environment. To do this several times daily in all rooms is

tiresome, time-consuming and on account of today's typical work and living habits totally infeasible.

Automatic room ventilation with heat recovery ensures that the air that needs to be exchanged from both a hygienic and constructional standpoint is exchanged in an energy-conscious and economically feasible manner.

Advantages of domestic ventilation units

- Fresh, clean air without indoor air pollutants and excessive humidity
- Automatic management of the required number of daily ventilation procedures without requiring active assistance
- Reduced ventilation losses through heat recovery
- Integrated filter for insects, dust and fine particle pollutants
- Screening of outside noise and increased security because windows remain closed
- Positive evaluation according to the German Federal Energy Efficiency Ordinance (EnEV)

The use of a mechanical domestic ventilation unit with heat recovery is essential in many cases. The preferred type of waste heat recovery should be clarified before making a decision regarding which type of ventilation system to install.

It makes sense to use the exhaust air from the de-aeration and ventilation of living quarters as an energy source for preparing domestic hot water, because buildings require both ventilation and hot water **all year round**. A second heat generator should be integrated whenever hot water consumption is high.

6.4 Basic Principles for Planning Domestic Ventilation Systems

This chapter gives an insight into the principles for planning domestic ventilation systems. The most important standards and regulations to be observed are DIN 1946 (T1, T2, T6) and DIN 18017. These specify the necessary volume flows which are used as a basis for planning the system. They are used to dimension the ducting system, the ventilator, the heat recovery system and other components.

Additional requirements:

- The air circulation in living quarters should not cause discomfort. In particular, the incoming fresh air should not be perceived as being a draught in parts of rooms where people spend their time.
- Irritating sound transmissions should be reduced using suitable measures (e.g. sound dampers, flexible, thermally-insulated and sound-insulated Isoflex air hoses).
- **Fire protection measures** for ventilation systems must comply with the relevant federal building codes. However, no special fire protection measures are normally required in the case of low-rise residential buildings (e.g. detached house with up to 2 storeys).
- Kitchen extractor hoods and vented tumble driers may not be connected to the domestic ventilation unit. It is better to operate the extractor hood in recirculating air operation and to use a condenser tumble dryer.
- **Safety information**
  The air flow required for combustion in domestic fireplaces (e.g. tile stoves) must be routed independently of the ventilation system. A competent chimney sweep should be involved in the planning of the system!

6.4.1 Calculation of the air volume

A plan showing the layout of the house and the use of the rooms is required for planning the system.

This plan is used to divide up the different sections of the building into fresh air, exhaust air and air overflow areas and to calculate the volume flows for the individual rooms.

Fresh air areas: all lounges and bedrooms.

Exhaust air areas: bathrooms, WCs, kitchens and laundry rooms.

Air overflow areas: all areas which are located between the fresh air and exhaust air areas, e.g. hallways.

Proof of the number of air exchanges

The fresh air and exhaust air volume flows for controlled room ventilation should be set so that the required number of air exchanges can be carried out.

$$LW = \frac{\dot{V}_{ab}}{V_R} \; [h^{-1}]$$

The number of air exchanges LW is the quotient of the exhaust air volume flow and the room volume.

For example:

An air exchange figure of 0.5 per hour means that half of the indoor air is replaced by fresh outside air in one hour or the total indoor air is renewed every 2 hours.

NOTE

The German Federal Energy Efficiency Ordinance EnEV compares the heat recovery using a ventilation system on the basis of a standard system with an air exchange figure of 0.4[1/h].

Calculation of exhaust air volume flows

Room	Exhaust air volume flow in m^3/h
Kitchen	60
Bathroom	60
WC	30
Laundry room	30

Table 6.1: Exhaust air volume flow according to DIN 1946, Part 6 and DIN 18017 “Lüftung von Bädern und Toiletten” [English: “Ventilation of Bathrooms and WCs”]

Calculation of the fresh air volume flows

The sum of the calculated exhaust air volume flows must equal the sum of the fresh air volume flows.

The volume flows of the individual rooms should be adjusted so that the number of air exchanges is within the given limits, and the fresh air volume flow equals the exhaust air volume flow.

Type of room	Air exchange	
	Min.	Max.
Lounges/bedrooms	0,7	1,0
Kitchen/bathroom/WC	2,0	4,0

Air exchanges in the building

The calculated total number of air exchanges in all rooms should be between 0.4 and 1 per hour.

Living space m	Planned occupancy	Fresh air flow m/h
Up to 50	Up to 2 persons	60
50 to 80	Up to 4 persons	120
Over 80	Up to 6 persons	180

Table 6.2: Fresh air volume flow according to DIN 1946, Part 6 and DIN 18017 "Lüftung von Bädern und Toiletten" [English: "Ventilation of Bathrooms and Toilets"]

6.4.2 Installation recommendations for domestic ventilation units and the positioning of the fresh air and exhaust air valves

The installation of domestic ventilation units and the routing of the air distribution system should be carried out within the thermal envelope of the building to minimize heat losses. Air ducting must be insulated whenever the ducts are routed through unheated or partly heated areas.

In the case of domestic ventilation units with integrated domestic hot water preparation, the device is normally installed in the cellar or laundry room with the aim of keeping the pipe runs as short as possible.

Air volume flows should be selected so that the greatest possible air volume flows from rooms with minimum air contamination (fresh air rooms) to rooms with higher air contamination (exhaust air rooms). The air overflow areas should be provided with the necessary air overflow vents. These can be air gaps under the doors (gap height approx. 0.75 cm) or a grill fitted in a wall or door.

Air circuit

The flow velocities in the pipe system should not be greater than 3 m/s in order to keep noise generation and pressure drops to a minimum. Fresh air valves and exhaust air valves should admit a max. of 30-50 m^3/h. Several valves should be installed to accommodate larger air volume flows.

Air volumes	Pipe diameter
Up to a max. 80 m^3/h	Folded spiral-seam DN 100
Up to a max. 130 m^3/h	Folded spiral-seam DN 125
Up to a max. 160 m^3/h	Folded spiral-seam DN 140
Up to a max. 220 m^3/h	Folded spiral-seam DN 160
Up to a max. 340 m^3/h	Folded spiral-seam DN 200

Fresh air (inblown air)

Doors and ceilings are preferred locations for fresh air valves because these areas are not obstructed by either furniture or curtains. Attention should be paid to a sufficient and even circulation in the fresh air area when designing the layout. In the case of decentralized systems, the fresh air vents should be positioned in the upper external wall (e.g. close to the ceiling in the vicinity of a window).

Exhaust air

The position of the exhaust air valves is of less importance for domestic ventilation than is the position of the fresh air valves. An appropriate position is in the ceiling or in the wall near the source of the air to be discharged.

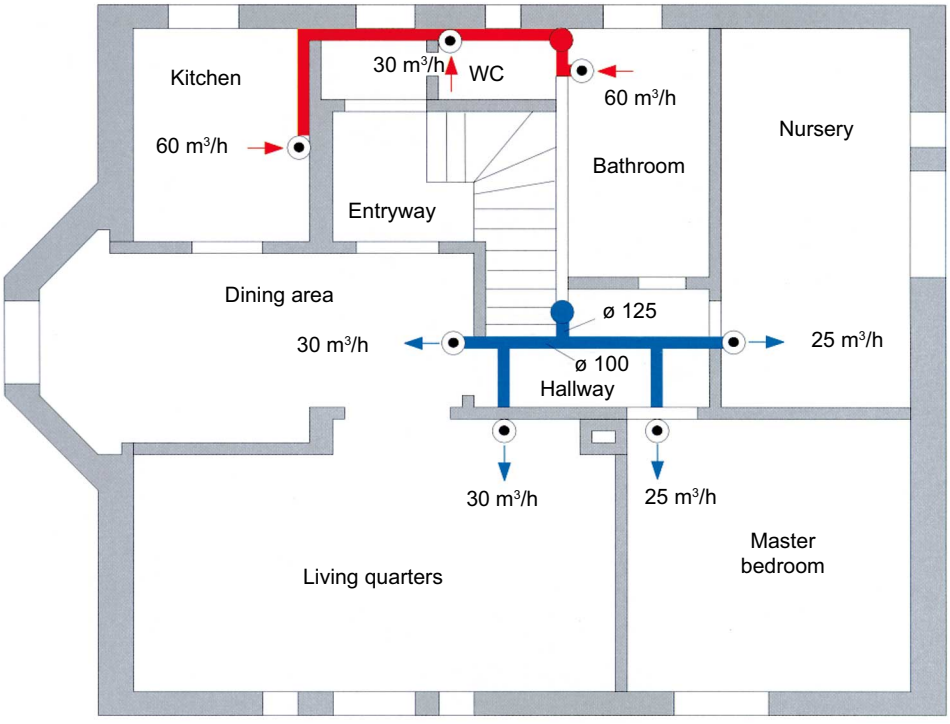


Fig. 6.8: Detail of a ventilation plan with a central fresh air and exhaust air system

6.4.3 Calculating the overall pressure drop

The overall pressure drop in the air distribution system is determined by calculating the most unfavourable pipe run. This is split into sections and the pressure drops of the individual components are determined on the basis of the respective volume flow and the pipe diameter. The overall pressure drop is equal to the total of the pressure drops of the individual components.

The calculated overall pressure drop must be within the permissible external compression of the domestic ventilation device.

Ventilation system packages

When ventilation system packages are implemented, the fresh air and exhaust air flows are routed individually from the rooms to the device. In contrast to standard ventilation construction methods, no air flows can be merged together or separated. This allows the use of standardised system packages which can be installed individually and without difficulty. The flexible air ducts can be laid side by side, thus saving space, and also preventing the transmission of sound between the various rooms (telephony).

It is unnecessary to calculate the overall pressure drop if the entire air distribution system is implemented using the standardised multipipe air distribution systems that are available for every type of domestic ventilation system, and the following points are taken into consideration.

- Short direct pipe runs
- Maximum run length 15 m
- Pipes which are delivered in a compressed condition should be fully stretched
- Routing should be favourable for the air flow with large bending radii (avoid tight 90°angles!).

6.5 Compact Domestic Ventilation Unit (Exhaust Air) LWP 300W

The compact domestic ventilation unit (exhaust air) continually draws in hot, humid air contaminated with pollutants from the kitchen, bathroom and WC, and actively extracts the heat required for domestic hot water preparation from the exhaust air volume flow.

The compact unit (exhaust air) is specially designed for the requirements of domestic ventilation and has the following advantages in addition to the basic features of a hot water heat pump:

- Permanent ventilation function independent of the hot water consumption
- Air volume flow adjustable for 120, 185 or 230 m^3) using a wall-mounted control unit
- A heat pump unit which delivers a high COP despite a relatively small but continuous volume flow
- Energy-efficient, direct current ventilator
- Constant electronic volume regulation to guarantee the selected air volume flow even if the pressure drops vary

⚠ ATTENTION!

The exhaust air volume flow must be determined on the basis of the type and expected use of the building. The most important standards and regulations to be observed are DIN 1946 T6 and DIN 18017. These specify the necessary volume flows which are used as a basis for planning the system.

i NOTE

The heating-up period for a 290 l hot water cylinder is approx. 6.2 hours for an air volume flow of 230 m^3 and a set hot water temperature of 45 °C. A lower air volume flow increases the length of the required heating-up period.

If hot water consumption is high, domestic hot water preparation can be assisted using the integrated heating element fitted as standard or using a second heat generator connected via an integrated tube heat exchanger.

2-pipe system for exhaust air/outgoing air

The compact domestic ventilation unit is equipped with one exhaust air stub and one out-going air stub (2 x DN 160).

The exhaust air stubs are connected to the central duct system. The exhaust air is expelled from damp, odour-contaminated exhaust air rooms in the building in a controlled way, and is conveyed outdoors via the out-going air stubs. The required fresh air (outside air) is fed into the building via the decentralized fresh air units.

The exhaust air system to be installed in the building is available in the form of an exhaust air system package with decentralized fresh air units in two different versions, the standard wall/ceiling system package and the wall/floor system package. There is also the option of integrating a standard duct system.

Exhaust air system package with fresh air units

In contrast to standard ventilation construction methods, when implementing either the wall/ceiling or wall/floor system package, the flexible Isoflex or Quadroflex hoses are routed individually from the exhaust air rooms to the air manifold on the domestic ventilation unit.

Exhaust air system package - wall/ceiling ALS D

This system package is used if the air distribution system can be routed exclusively through the walls, ceilings (e.g. wooden joist ceiling) or roof slopes. The flexible, thermally-insulated and sound-insulated Isoflex DN 80 air hoses are used.

Exhaust air system package - wall/floor ALS B

This type of system package is used if the air distribution system, e.g. of a storey, must be laid above the bare floor of the storey above. The flexible, thermally-insulated and sound-insulated Isoflex DN 80 air hoses are used for routing through walls and ceilings. If the system is to be installed on the bare floor, Quadroflex pipes (80 x 50) is used.

Exhaust air system package with decentralized fresh air units	Wall/ceiling ALS D	Wall/floor ALS B
External wall grill	1 item	1 item
Flush-mounted box for external wall grill	1 item	1 item
Exhaust air valve with filter	6 items	6 items
Constant volume flow controller	3 items	3 items
Isoflex DN80 hose (each 10 m)	10 items	4 items
Hose connector	4 items	2 items
Isoflex DN160 hose (each 10 m)	1 item	1 item
6-way air manifold	1 item	1 item
Fresh air unit for external wall	6 items	6 items
80 x 50 Quadroflex pipe (each 5 m)		6 items
90° elbow		4 items
Straight coupling		4 items
Assembly material	1 set	1 set

Fig. 6.9: Domestic ventilation unit (exhaust air) LWP 300W

6.6 Device Information for Compact Domestic Ventilation Units (Exhaust Air)

Device information for compact domestic ventilation systems (exhaust air)			
Compact domestic ventilation unit (exhaust air)			**LWP 300W**
Design			With additional internal heat exchanger
Nominal cylinder volume		**(litre)**	290
Cylinder material			Enamelled steel according to DIN 4753
Nominal cylinder pressure		**(bar)**	10
Dimensions W x H x D (overall)		**(cm)**	66 x 65 x 170
Weight (empty)		**(kg)**	Approx. 175
Electrical connection			230V ~ 50Hz
Fuse		**(A)**	16
Refrigerant R134a, total filling weight		**(kg)**	0.8
Performance data			
Air temperature operating range of heat pumps		**(°C)**	15 to 30
Selectable water temperature (heat pump operation $^{\pm 1.5K}$)		**(°C)**	23 to 60
Heating-up period from 15 °C to 60 °C	**at (L20 / F50)**	**(h)**	10.3
Power consumption supplementary electric heating		**(Watt)**	1500
Mean power consumption [1]	**at 45 °C**	**(Watt)**	470
Mean heat output [1]	**at 45 °C**	**(Watt)**	1590
COP (t) according to EN 255	**at 45 °C**		3.4
Stand-by energy consumption	**at 45°C / 24h**	**(Watt)**	47
Sound pressure level [2]		**(dB(A))**	53
Air flow: level I / II / III		**(m^3/h)**	120 / 185 / 230
Mean power consumption - fan level I / II / III		**(W)**	15 / 28 / 45
External compression		**(Pa)**	200
Air duct connection cross-section		**(mm)**	160
Transfer area of the internal heat exchanger		**(m²)**	1.45
Sensor pipe $\varnothing_{internal}$ (for heat exchanger operation)		**(mm)**	12
Circulation pipe connection	**external thread**		R ¾“
Hot water outlet connection	**external thread**		R1“
Cold water inlet connection	**external thread**		R1“
Internal heat exchanger connection	**external thread**		R1“

1. Heating up of the nominal volume from 15 °C to 45 °C with L20 / F50 = exhaust air temperature 20 °C and exhaust air humidity 50% and fan level III
2. At a distance of 1 m (free-standing installation or installation without exhaust air duct or 90° pipe bends on the exhaust air side)

6.7 Comparison of the Convenience and the Costs of Different Types of Domestic Hot Water Heating Systems

6.7.1 Decentralized domestic hot water supply (e.g. continuous-flow heaters)

Advantages in comparison to heat pumps for heating purposes:

a) Smaller investment
b) Minimal space requirement
c) Increased heat pump availability for space heating (particularly in the case of monovalent operation and during shut-off times)
d) Low water losses
e) No downtime losses or circulation losses

Disadvantages in comparison to heat pumps for heating purposes:

a) Higher operating costs
b) Loss of comfort because the hot water temperatures are dependent on the tap speed (in the case of hydraulic devices)

6.7.2 Cylinder with electric immersion heater (off-peak electricity)

Advantages in comparison to heat pumps for heating purposes:

a) Smaller investment
b) Higher hot water temperatures possible in the cylinder (but often not required!)
c) Increased heat pump availability for space heating (particularly in the case of monovalent operation and during shut-off times).

Disadvantages in comparison to heat pumps for heating purposes:

a) Higher operating costs
b) Only limited availability
c) Increased lime scaling possible
d) Longer heating-up periods

6.7.3 Domestic hot water heat pump

Advantages in comparison to heat pumps for heating purposes:

a) A cooling or dehumidification effect can be produced at the installation location (e.g. storage cellar) in the summertime
b) Increased heat pump availability for space heating (particularly in the case of monovalent operation and during shut-off times)
c) Easy integration of solar thermal systems
d) Higher hot water temperatures when only the heat pump is in operation

Disadvantages in comparison to heat pumps for heating purposes:

a) Considerably longer domestic hot water cylinder reheating times
b) Heat output is normally insufficient if the domestic hot water consumption is high
c) The installation room could become cold in the wintertime

6.7.4 Domestic ventilation unit with domestic hot water preparation

Advantages in comparison to heat pumps for heating purposes:

a) Comfortable domestic ventilation to ensure hygienic air circulation
b) Domestic hot water preparation using active year-round heat recovery from exhaust air
c) Increased heat pump availability for space heating (particularly in the case of monovalent operation and during shut-off times)
d) Easy integration of solar thermal systems
e) Higher hot water temperatures when only the heat pump is in operation

Disadvantages in comparison to heat pumps for heating purposes:

a) Considerably longer hot water cylinder reheating times with heat pump operation
b) Combination with a second heat generator is essential if the hot water consumption is high

6.7.5 Summary

Heating domestic hot water with a heat pump is practical and economical on account of the good performance factor.

Domestic hot water for normal usage should be prepared using a domestic ventilation unit if living space ventilation is necessary or desired. The installed air-to-water heat pump extracts the stored energy in the exhaust air and uses it for year-round domestic hot water preparation.

Electric hot water heaters can also be appropriate depending on the tariff structure of the local utility company, the domestic hot water consumption, the required temperature level and the location of the extraction points.

7 Heat Pump Manager

The heat pump manager is essential for operation of air-to-water, brine-to-water and water-to-water heat pumps. It regulates a bivalent, monovalent or mono energy heating system and monitors the safety components in the refrigerating circuit. The heat pump manager is either installed in the heat pump casing or is delivered with the heat pump as a wall-mounted controller. It carries out regulation of both the heating system (radiators and circulation pump) and the heat source system.

Overview of functions

- Convenient 6-button operation
- Large and clear illuminated LC display with indicators for operating status and service information
- Conforms with utility company requirements
- Dynamic menu navigation, customised for the configured heat pump system
- Remote control interface with identical menu navigation
- Return temperature-controlled regulation of heating operation based on external temperature, adjustable fixed-setpoint or room temperature
- Control of up to 3 heating circuits
- Priority switching
  – Cooling first
  – DHW preparation first
  – Heating first
  – Swimming pool
- Control of a 2nd heat generator (oil or gas boiler, or immersion heater)
- Control of a mixer for a 2nd heat generator (oil, gas, solid fuel boiler, or renewable heat source)
- Special program for a 2nd heat generator to ensure minimum runtimes (oil boiler) or minimum heating times (main cylinder)
- Control of a flange heater for targeted reheating of domestic hot water with adjustable time programs, and for thermal disinfection
- Optional control of up to 5 circulating pumps
- Defrost management system to minimise the energy required for defrosting using variable, self-adjusting defrosting cycle times
- Compressor management system to ensure balanced loading of the compressors for heat pumps with two compressors
- Operating hours counter for compressors, circulating pumps, 2nd heat generator and flange heater
- Keyboard block, child lock
- Alarm memory with time and date
- Interface for communication via PC with optional display of heat pump parameters
- Automatic program for targeted heat drying of screed floors and saving the start and finish times

7.1 Operation

- The heat pump manager is operated using 6 keys: Esc, Modus, Menu, ⇓, ⇑, ↵ . Different functions are assigned to these buttons according to the current display (Standard or Menu).
- The operating status of the heat pump and the heating system is indicated in plain text on a 4 x 20 character LC display.
- 6 different operating modes can be selected: Cooling, Summer, Auto, Party, Vacation, 2nd heat generator.
- The menu consists of 3 main levels: Settings, Operating data, History.

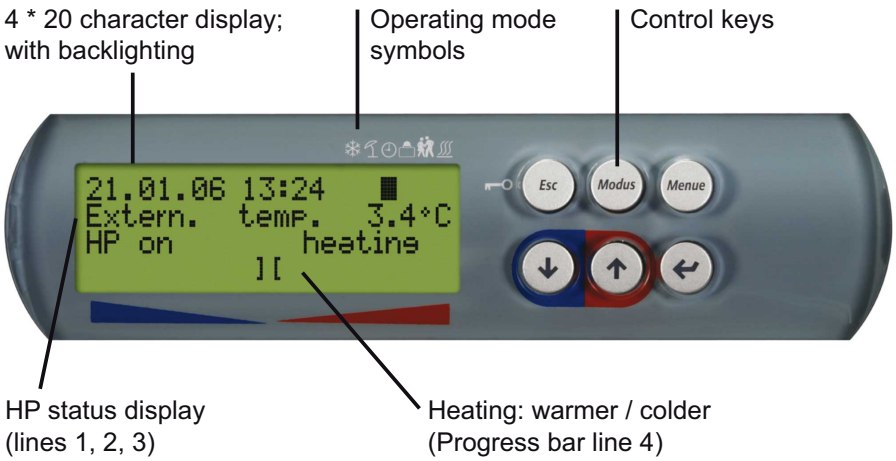


Fig. 7.1: Standard LC display - main display with operator buttons

NOTE

The display can be adjusted for contrast. Do this by depressing the buttons (MENU) and (↵) at the same time until the adjustment process has been completed.
Increase the contrast by simultaneously pressing the (⇑) button. Reduce the contrast by pressing the (⇓) button.

NOTE

Keyboard block, child lock!
To prevent unintentional adjustment of the heat pump manager, press the button (Esc) for approx. 5 seconds until KEY BLOCK ACTIVE appears on the display. Cancel the keyboard block using the same procedure.

Button	Standard display (*Fig. 7.1 on p. 167*)	Change of setting
Esc	■ Activates or deactivates the keyboard block ■ Acknowledges a fault	■ Exits the menu and returns to the main display ■ Returns from a submenu ■ Exits a setting without saving changes
Operation	■ Selection of the operating mode	No action
Menu	■ Jumps to menu	No action
⇓	■ Shifts the heating curve downwards (colder)	■ Scrolls downwards between menu items on one level ■ Changes a setting in a downward direction
⇑	■ Shifts the heating curve upwards (warmer)	■ Scrolls upwards between menu items on one level ■ Changes a setting in an upwards direction
↵	No action	■ Selects a setting in the corresponding menu item ■ Exits a setting and saves changes ■ Jumps to a submenu

Table 7.1: Operator button functions

7.1.1 Attaching the wall-mounted heat pump manager (heating)

The controller is attached to the wall with the 3 screws and dowels (6 mm) included in the scope of supply. The following mounting procedure should be used to avoid soiling or damaging the controller:

- Mount the dowels for the upper fastening eye at operator level.
- Screw the screw into the dowel so that the controller can be hung up.
- Hang the controller on the upper fastening eye.
- Mark the position of the side fastening eyes.
- Remove the controller.
- Mount the dowels for the side fastening eyes.
- Rehang the controller and tighten the screws.

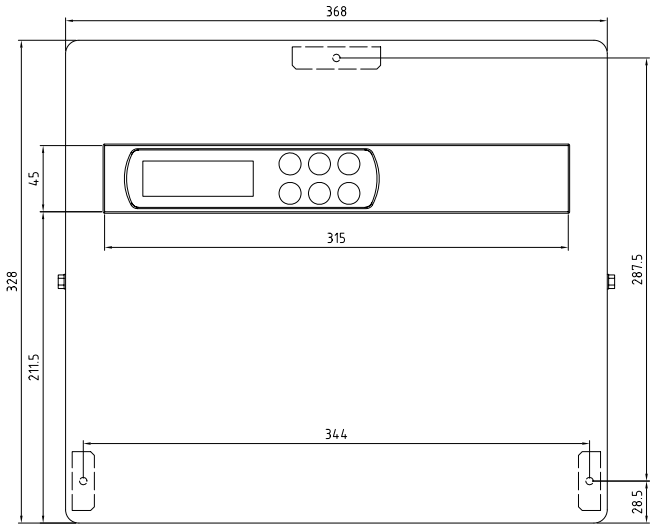


Fig. 7.2: Dimensions of the wall-mounted heat pump manager (heating)

7.1.2 Temperature sensor (heating controller N1)

Depending on the type of heat pump implemented, the following temperature sensors are already installed or must be additionally mounted:

- Outside temperature (R1) (see *Chap. 7.1.2.3 on p. 169*)
- Temperature 1st, 2nd and 3rd heating circuit (R2, R5 and R13)
  (see *Chap. 7.1.2.4 on p. 169*)
- Flow temperature (R9), as flow sensor in the case of air-to-water heat pumps
- Outlet temperature of the heat source in the case of brine-to-water and water-to-water heat pumps
- Hot water temperature (R3)
- Temperature of regenerative heat accumulator (R13)

The heating controller N1 is available in 2 versions:

- Heating controller with integrated display (WPM 2006 plus) (see *Chap. 7.1.2.1 on p. 168*)
- Heating controller with removable control panel (WPM 2007 plus) (see *Chap. 7.1.2.2 on p. 169*)

	Temperature [°C]									
	-20	**-15**	**-10**	**-5**	**0**	**5**	**10**	**15**	**20**	**25**
Standard NTC-2 in kΩ	14.62	11.38	8.94	7.07	5.63	4.52	3.65	2.92	2.43	2.00
Standard NTC-10 in kΩ	67.74	53.39	42.29	33.89	27.28	22.05	17.96	14.86	12.09	10.00

7.1.2.1 Heating controller with integrated display (WPM 2006 plus)

All temperature sensors to be connected to the heating controller with integrated display must correspond to the sensor characteristic curve shown in *Fig. 7.4 on p. 169*.

Fig. 7.3: Heating controller with integrated display

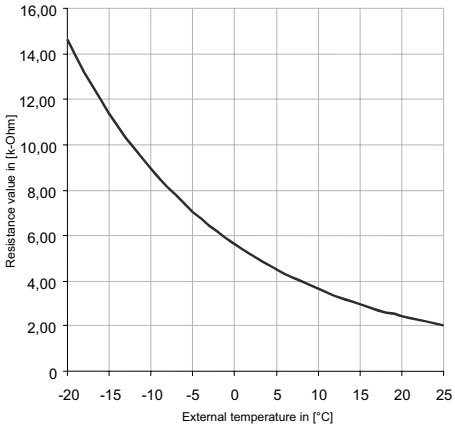


Fig. 7.4: Sensor characteristic curve standard NTC-2 according to DIN 44574 for connecting temperature sensors to the heating controller with integrated display

7.1.2.2 Heating controller with removable control panel (WPM 2007 plus)

All temperature sensors to be connected to the heating controller with removable control panel must correspond to the sensor characteristic curve shown in *Fig. 7.6 on p. 169*. The only exception is the external temperature sensor included in the scope of supply of the heat pump (see *Chap. 7.1.2.3 on p. 169*)

Fig. 7.5: Removable control panel

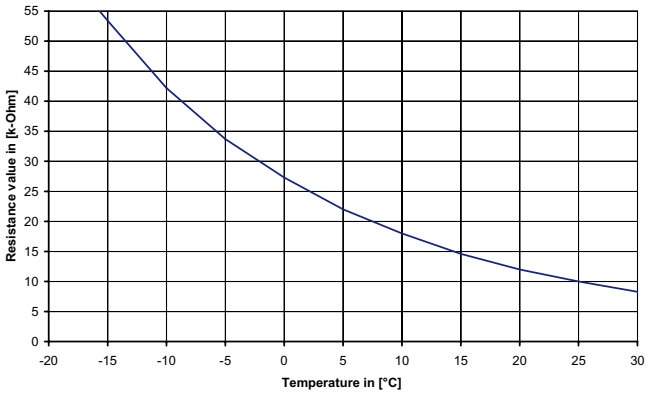


Fig. 7.6: Sensor characteristic curve NTC-10 for connecting temperature sensors to the heating controller with removable control panel

7.1.2.3 Mounting the external temperature sensor

The temperature sensor must be mounted so that all weather conditions are taken into consideration and the measured value is not falsified.

Installation:

- On the external wall of a heated room used as living space, if possible on the north or north-west side of the building
- Not in a “sheltered position” (e.g. niche in a wall or under a balcony)
- Not in the vicinity of windows, doors, exhaust air vents, external lighting or heat pumps
- Must not be exposed to direct sunlight at any time of year

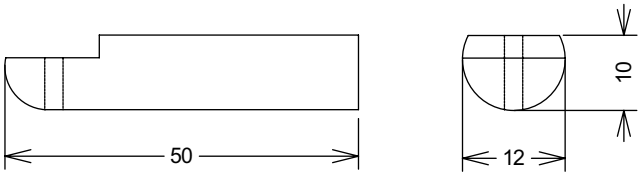


Fig. 7.7: Dimensions of the external sensor in insulated casing

7.1.2.4 Mounting the Return Flow Temperature Sensor

It is only necessary to mount the return flow sensor if it is included in the scope of supply of the heat pump, but has not yet been installed.

The return flow sensor can be fitted as a pipe-mounted sensor or installed in the immersion sleeve of the compact manifold.

- Remove paint, rust and scale from heating pipe.
- Coat cleaned surface with heat transfer compound (apply sparingly).
- Attach sensor with hose clip (tighten firmly as loose sensors can cause malfunctions) and thermally insulate.

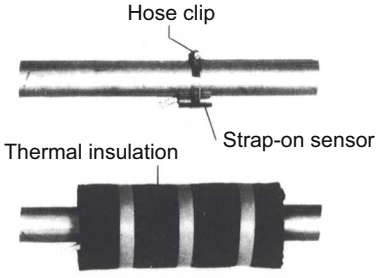


Fig. 7.8: Mounting a pipe-mounted sensor

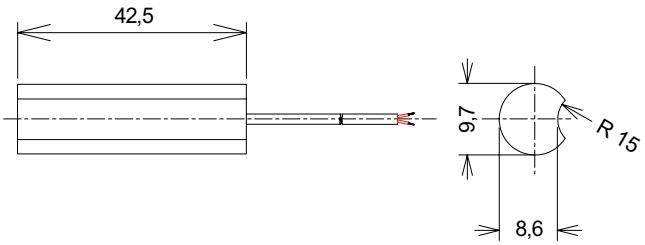


Fig. 7.9: Dimensions of the return flow sensor standard NTC-2 in a metal casing

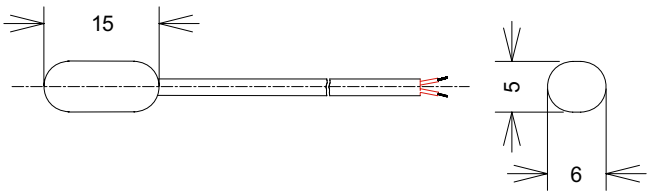


Fig. 7.10: Dimensions of the return flow sensor standard NTC-2 in a plastic casing

7.2 General Menu Structure

The heat pump manager provides numerous setting and control parameters (see *Table 7.2 on p. 171*)

Preconfiguration

The preconfiguration informs the controller about which components are connected to the heat pump heating system. Preconfiguration must be carried out before the actual configuration in order to be able to show or hide system-specific menu items (dynamic menus).

Configuration

The menus for “Outputs”, “Inputs”, “Special functions” and “Modem” as well as the extended setting menu can be set at the menu level for experts.

- Preconfiguration
  - Operating mode
  - Additional heat exchanger
  - 1. Heating circuit 1
  - 2. Heating circuit 1
  - 3. Heating circuit 1
  - Cooling function active
  - Passive cooling function
  - Passive cooling function - system design
  - Domestic hot water preparation
    - DHW preparation request by
    - DHW preparation - immersion heater
  - Swimming pool preparation
  - Low pressure brine - measurement present
  - Low-pressure brine

- Settings
  - Time
  - Operation
    - Operating mode
    - Party mode - number of hours
    - Vacation mode - number of days
  - Heat pump
    - No. of compressors
    - Operating temp. limit
    - High press. switch
    - Low pressure
  - 2. Heat generator
    - HG2 limit value
    - HG2 mode of operation
    - HG2 mixer runtime
    - HG2 mixer hysteresis
    - Utility block (EVU)
    - Lim. temp. Utility 3
    - HG2 special program
    - HG2 overtemperature bivalent-renewable
    - HG2 overtemperature bivalent-renewable
  - 1. Heating circuit 1
    - 1. HC control via
    - 1. HC heating curve end point (-20°C)
    - 1. HC fixed-setpoint reg. Return flow set temp.
    - 1. HK reference room room set temperature
    - 1. HC return flow min. temperature
    - 1. HC Return flow max. temperature
    - 1. HC hysteresis return flow set temp.
    - 1. HC time program lower
      - 1. HC reduction
      - 1. HC lower - lower value
      - 1. HC lower MO ... SU
    - 1. HC time program raise
      - 1. HC raise Time1 ... Time2
      - 1. HC raise - raise value
      - 1. HC raise MO ... SU
  - 2. Heating circuit/heating circuit 3
    - HC 2/3 control via
    - HC 2/3 temperature sensor
    - HC 2/3 heating curve end point (-20°C)
    - HC 2/3 colder/warmer
    - HC 2/3 fixed-setpoint Set temp.
    - HC 2/3 return flow maximum value
    - HC 2/3 mixer hysteresis
    - HC 2/3 mixer runtime
    - HC 2/3 time program reduction
      - HC 2/3 lower
      - HC 2/3 lower value reduction
      - HC 2/3 reduction MO ... SU
    - HC 2/3 time program raise
      - HC2/3 raise Time1 ... Time2
      - HC 2/3 raise - raise value
      - HC 2/3 raise MO ... SU
  - Cooling
    - Cooling - dynamic cooling
    - Dynamic cooling setpoint (ret.)
    - Cooling - silent cooling
    - Silent cooling - number room stations
    - Silent cooling setpoint (room temp.)
    - Silent cooling dew point distance
    - 2. Chiller 2
    - Cooling temperature limit
  - Domestic hot water

- Settings
  - Hot water switch comp2
  - Hot water hysteresis
  - Domestic hot water parallel heating - DHW
  - Hot water max. temp. - parallel
  - Hot water parallel cooling - DHW
  - Hot water set temperature
  - Hot water block
    - Hot water block
    - Hot water block
  - Thermal disinfection
    - Activation of thermal disinfection
    - Thermal disinfection temperature
    - Thermal disinfection
  - Hot water reset HP maximum
  - Swimming pool
    - Swimming pool
      - Swimming pool block Time1 ... Time2
      - Swimming pool block MO ... SU
  - Plant - Pump control
    - Auxiliary pump for heating
    - Auxiliary pump for cooling
    - Auxiliary pump for hot water
    - Auxiliary pump for swimming pool
  - Date Year Day Month Day of week
  - Language

- Operating data
  - External temperature
  - Return flow set temp. - 1. Heating circuit 1
  - Return flow temp. - 1. Heating circuit 1
  - Flow temp. Heat Pump
  - Set temp. Heating circuit 2
  - Minimum temperature - heating circuit 2
  - Temperature - heating circuit 2
  - Set temp. Heating circuit 3
  - Temperature - heating circuit 3
  - Heating request
  - Bivalence level
  - Defrost end sensor
  - Temperature cylinder regenerative
  - Return temperature - passive cooling
  - Flow temperature - passive cooling
  - Antifreeze - cool - cooling
  - Room temperature 1 set temperature
  - Room temperature 1
  - Humidity room 1
  - Room temperature 2
  - Humidity room 2
  - Cooling request
  - Hot water set temp.
  - Hot water temp.
  - Hot water request
  - Swimming pool request
  - Flow temperature limit sensor
  - Coding
  - Heating software
  - Cooling software
  - Network heating / cooling

- History
  - Compressor 1 runtime
  - Compressor 2 runtime
  - 2. HG2 runtime
  - Primary pump runtime
  - Ventilator runtime
  - Heating pump runtime
  - Cooling runtime
  - Hot water pump runtime
  - Swimming pool pump runtime
  - Immersion heater runtime
  - Alarm memory No. 2
  - Alarm memory No.1
  - Initial heating begin / end
  - Screed drying begin / end

- Outputs
  - Compressor 1
  - Compressor 2
  - Four-way valve

- Outputs
  - Ventilator / primary pump
  - 2. Heat generator 2
  - Mixer open - heat generator 2
  - Mixer closed - heat generator 2
  - Mixer OPEN - heating circuit 3
  - Mixer CLOSED - heating circuit 3
  - Heating pump
  - Heating pump - heating circuit 1
  - Heating pump - heating circuit 2
  - Mixer OPEN - heating circuit 2
  - Mixer CLOSED - heating circuit 2
  - Auxiliary pump
  - Cooling pump
  - Switch room thermostat
  - Reversing valve cooling
  - Hot water pump
  - Immersion heater
  - Swimming pool pump

- Inputs
  - Low-pressure switch
  - High-pressure switch
  - Defrost end switch
  - Flow rate monitoring
  - Hot gas thermostat
  - Flow temp. limit thermostat
  - Motor protection compressor
  - Motor protection primary pump
  - Utility block (EVU)
  - Ext. disable contact
  - Low-pressure brine controller
  - Dew point monitor
  - Hot water thermostat
  - Swimming pool thermostat

- Special functions
  - Compressor switch
  - Quick start
  - Deactivate operating
  - Start-up
  - System control
    - System monitoring primary side
    - System monitoring secondary side
    - System monitoring hot water pump
    - System monitoring mixer
  - Initial heating prog
    - Initial heating program maximum temperature
    - Hot water / swimming pool active
    - Initial heating
    - Standard program screed drying
    - Individual program heating-up period
    - Individual program maintaining time
    - Individual program heating-down period
    - Individual program diff. temp.- heating-up
    - Individual program diff. temp. - heating down
    - Individual program screed drying
  - Measurement temperature difference
  - Measure monitor defrost
  - Service
    - After-sales service for defrost
    - After-sales service for hot gas defrost
    - AE special function
    - DA special function
    - DE special function
    - AEK special function
    - DK special function
    - DHW special function
    - External temperature sensor
    - Display test
  - Performance levels K

- Modem
  - Baud rate
  - Address
  - Protocol
  - Password
  - Phone number
  - Dialling method
  - Number of rings until call answered
  - Manual dialling

Table 7.2: Menu structure heat pump manager software version H_H_5x

7.3 Circuit Diagram of the Wall-Mounted Heat Pump Manager

Legend

A1	The utility bridge (J5/ID3-EVS to X2) must be inserted if there is no utility blocking contactor (contact open = utility block).
A2	SPR bridge (J5/ID4-SPR to X2) must be removed, if the input is used (input open = heat pump off).
A3	Bridge (M11 fault). A floating NC contact can be used in place of A3 (e.g. protective motor switch).
A4	Bridge (M1 fault). A floating NC contact can be used in place of A4 (e.g. protective motor switch).
B2*	Low-pressure brine controller
B3*	Hot water thermostat
B4*	Swimming pool water thermostat
E9	Flange heater for hot water
E10*	Second heat generator (boiler or electric heating element)
F1	Control fuse N1 5x20 / 2.0 A slow-acting
F2	Load fuse for plug-in terminals J12 and J13 5 x 20 / 4.0 A Tr
F3	Load fuse for plug-in terminals J15 to J18 5 x 20 / 4.0 A Tr
H5*	Remote fault indicator lamp
J1	Control unit power supply connection (24 V AC / 50 Hz)
J2	Connection for hot water sensor, return flow sensor and external sensor
J3	Input for HP code and flow sensor using control line plug connector X8
J4	Output 0-10 V DC for controlling frequency converter, remote fault indicator, swimming pool circulating pump
J5	Connection for hot water thermostat, swimming pool thermostat and utility block function
J6	Connection for heating circuit 2 sensor and defrost end sensor
J7	Connection for “low-pressure brine” alarm message
J8	230 V AC inputs and outputs for control of the WP X11 control line plug connector
J9	Socket not used
J10	Socket for connecting the remote control (6-pole)
J11	Connection not used
J12 to J18	230V AC - Outputs for controlling the system components (pump, mixer, heating element, solenoid valves, boiler)
K9	230 V/ 24 V coupling relay
K11*	Electronic relay for remote fault indicator
K12*	Electronic relay for swimming pool water circulating pump
K20*	Contactor for 2nd heat generator
K21*	Contactor - electr. flange heater for hot water
K22*	Utility blocking contactor (EVS)
K23*	Auxiliary relay for SPR
M11*	Primary pump
M13*	Heat circulating pump
M15*	Heat circulating pump for heating circuit 2
M16*	Auxiliary circulating pump
M18*	Hot water circulating pump
M19*	Swimming pool water circulating pump
M21*	Mixer for main circuit or heating circuit 3
M22*	Mixer for heating circuit 2
N1	Control unit
N10	Remote control
N11	Relay module
R1	External wall sensor
R2	Return flow sensor
R3	Hot water sensor
R5	Sensor for heating circuit 2
R9	Flow sensor
R12	Defrost end sensor
R13	Sensor for heating circuit 3
T1	Safety transformer 230 / 24 V AC / 28 VA
X1	Terminal strip - supply connection, N and PE distribution board
X2	Distribution board terminal 24 V AC
X3	Distribution board terminal ground
X8	Control line plug connector (extra-low voltage)
X11	230 V AC control line plug connector

Abbreviations:

MA	Mixer “OPEN”
MZ	Mixer “CLOSED”
*	Components to be supplied from external sources

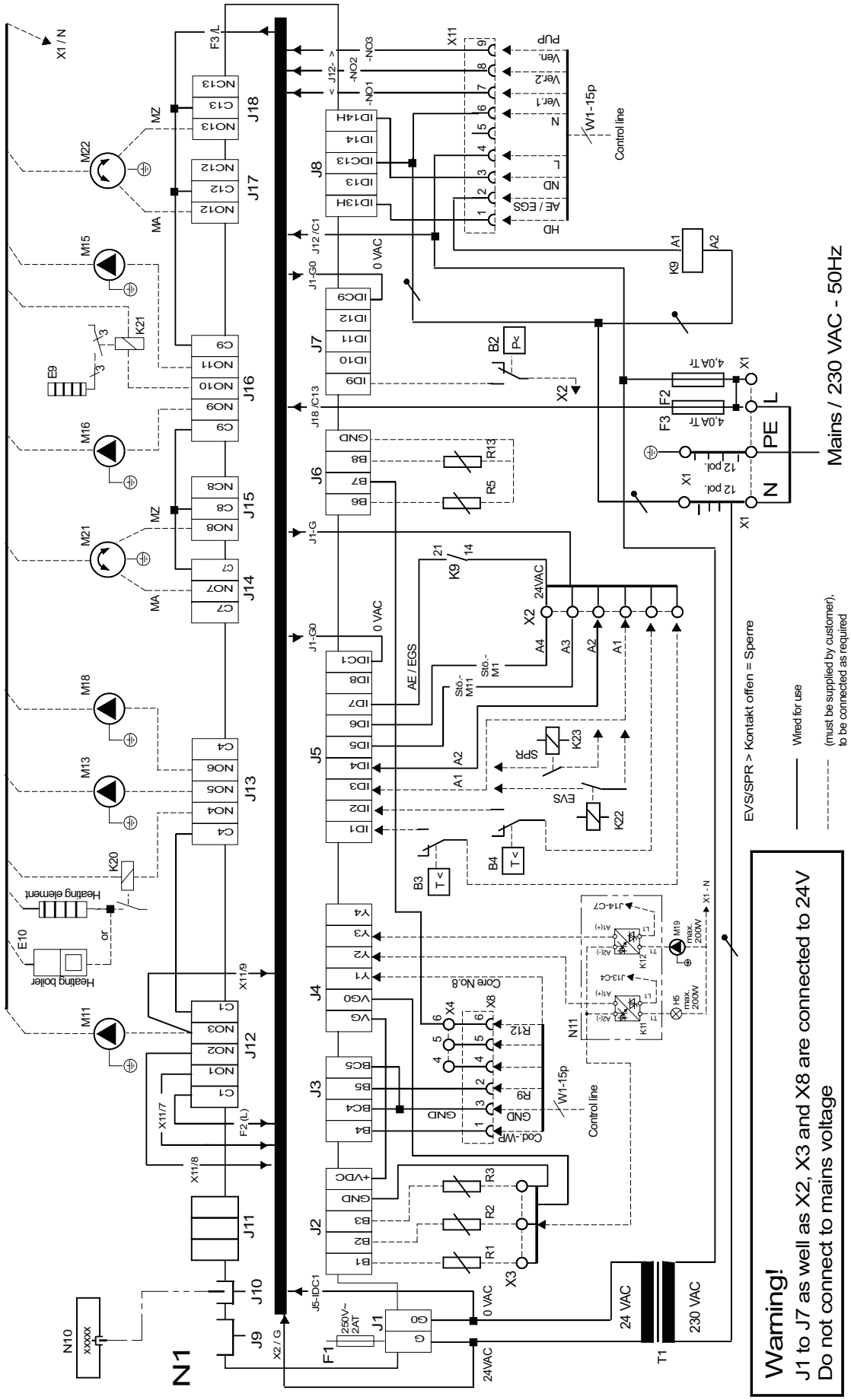


Fig. 7.11: Circuit diagram of the wall-mounted heat pump manager WPM 2006 plus (N1 heating controller)

7.4 Connection of External System Components

Inputs

Connection		Explanation
J2-B1	X3	External sensor
J2-B2	X3	Return flow sensor
J2-B3	X3	Hot water sensor
J3-B5	X3	Flow sensor (antifreeze)
J6-B6	J6-GND	Sensor for heating circuit 2
J6-B8	J6-GND	Sensor for heating circuit 3
J5-ID1	X2	Hot water thermostat
J5-ID2	X2	Swimming pool thermostat
J5-ID3	X2	Utility block
J5-ID4	X2	Ext. disable contact
J5-ID5	X2	Primary pump / ventilator fault
J5-ID6	X2	Compressor fault
J7-ID9	X2	Low-pressure brine

Outputs

Connection		Explanation
J12-NO3	N / PE	Primary pump / ventilator
J13-NO4	N / PE	2. Heat generator
J13-NO5	N / PE	Heat circulating pump
J13-NO6	N / PE	Hot water circulating pump
J14-NO7	N / PE	Mixer OPEN
J15-NO8	N / PE	Mixer CLOSED
J16-NO9	N / PE	Auxiliary circulating pump
J16-NO10	N / PE	Flange heater, hot water
J16-NO11	N / PE	Heat circulating pump for heating circuit 2
J17-NO12	N / PE	Mixer OPEN - heating circuit 2
J18-NO13	N / PE	Mixer CLOSED - heating circuit 2
J4-Y2	X2	Remote fault indicator
J4-Y3		Swimming pool circulating pump

NOTE

With the WPM 2006 plus, the remote fault indicator and the swimming pool pump are connected via the RBG WPM relay module which is available as a special accessory.

7.5 Technical Data of the Heat Pump Manager

Supply voltage		230 V AC 50 Hz
Voltage range		195 to 253 V AC
Power consumption		Approx. 14 VA
Degree of protection according to EN 60529; protection class according to EN 60730		IP20
Switching capacity of outputs		Max. 2 A (2 A) cos (φ) = 0.4 at 230 V
Operating temperature		0 °C to 35 °C
Storage temperature		-15 °C to +60 °C
Weight		4 100 g
Party setting range	Standard time	0 – 72 hours
Vacation setting range	Standard time	0 – 150 days
Temperature measuring range	External wall temperature	-20 °C to +80 °C
	Return temperature	-20 °C to +80 °C
	Flow sensor (flow temperature)	-20 °C to +80 °C
Heating controller setting range	Limit temperature boiler release	-20 °C to +20 °C
	Maximum return temperature	+20 °C to +70 °C
	Warmer/colder	+5 °C to +35 °C
	Hysteresis/neutral zone	+0.5 °C to +5.0 °C
Setting range Lower operation / raise operation	Warmer/colder	+5 °C to +35 °C
Setting range Hot water basic temperature	Set temp.	+30 °C to +55 °C
Setting range Hot water reheating	Set temp.	+30 °C to +80 °C
Mixer setting range	Mixer runtime	1-6 minutes

Compliance with utility requirements

- Switch-on delay when supply voltage is recovered or utility shut-off time is lifted (10 s to 200 s)
- The heat pump compressors are switched on a maximum of three times per hour.
- Heat pump is switched off by the utility blocking signal with the option of switching on the second heat generator.

General information

- Self-adjusting defrosting cycle time
- Monitoring and fusing equipment of the refrigerating cycle according to DIN 8901 and DIN EN 378
- Identification of the respective optimum mode of operation with the largest possible heat pump proportion
- Antifreeze function

Low-pressure brine controller for installation in the brine circuit (special accessory)

8 Integration of the Heat Pump in the Heating System

8.1 Hydraulic Requirements

During the hydraulic integration of a heat pump it must be kept in mind that the heat pump only has to generate the actually required temperature level to increase efficiency. The objective is to feed the temperature level generated by the heat pump directly (unmixed) into the heating system.

NOTE

A mixed heating circuit only becomes necessary when two different temperature levels must be supplied (e.g. for underfloor and radiator heating systems).

To prevent a mixing of the different temperature levels, the heating operation is stopped during a hot water requirement and the heat pump is operated with the higher flow temperatures necessary for domestic hot water preparation.

The following basic requirements must be fulfilled:

- Guarantee Frost Protection *Chap. 8.2 on p. 175*
- Safeguard the Heating Water Flow *Chap. 8.3 on p. 175*
- Ensure the Minimum Runtime *Chap. 8.5 on p. 180*

8.2 Guarantee Frost Protection

If a heat pump is positioned outside or if outside air flows through the heat pump, measures must be taken to prevent a freezing of the heating water during standstill periods or faults.

If the temperature level falls below a minimum temperature level set at the flow sensor (flow temperature) of the heat pump, the heat and auxiliary circulating pumps are automatically activated to ensure frost protection. In mono energy or bivalent systems the second heat generator is released in case of heat pump faults.

ATTENTION!

In heating systems with utility company shut-off timesthe supply cable for the heat pump manager must be supplied with constant voltage (L/N/PE~230V, 50Hz). For this reason, it should be tapped upstream from the utility blocking contactor or be connected to the household current.

The heating circuit should be operated with a suitable antifreeze if heat pump systems are implemented in buildings where a power failure can not be detected (e.g. holiday home).

In constantly occupied buildings the use of antifreeze in the heating water is not recommended since the frost protection is ensured to the greatest possible extent through the heat pump controller and an antifreeze reduces the efficiency of the heat pump.

A method of manual drainage should be provided for heat pumps which are exposed to frost. The system should be drained at three locations, and if required, blown out whenever it is taken out of service or in the event of a power failure.

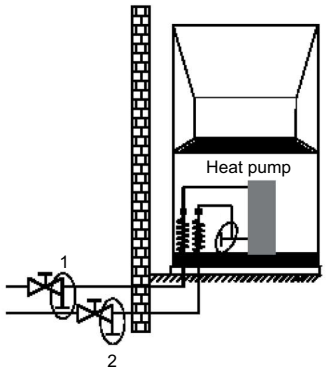


Fig. 8.1: Circuit diagram for installation of a heat pump exposed to frost

ATTENTION!

The hydraulic integration must be carried out such that the flow is maintained through the heat pump - and thus the integrated sensors - at all times even in case of a special integration or bivalent operation.

8.3 Safeguard the Heating Water Flow

The minimum heating water flow rate listed in the device information must be maintained for all operating statuses to guarantee the functional operation of the heat pump. The circulating pump should be dimensioned so that the water flow through the heat pump is also maintained even if there is a maximum pressure drop in the system (almost all heating circuits closed).

The required temperature spread can be determined in two possible ways:

- Arithmetical calculation *Chap. 8.3.1 on p. 175*
- Reading out of tabular values in relation to the heat source temperature *Chap. 8.3.2 on p. 176*

8.3.1 Arithmetic calculation of the temperature spread

- Determination of the current heat output of the heat pump from the heat output curves at the average heat source temperature.
- Calculation of the required temperature spread using the minimum heating water flow rate listed in the device information.

NOTE

Tabular values for the required temperature spread in relation to the heat source temperature can be found in *Chap. 8.3.2 on p. 176.*

Example: Air-to-water heat pump:

Heat output $\dot{Q}_{HP}$ = 10.9 kW at A10/W35

Specific heat capacity of water: 1.163 Wh/kg K

Required minimum heating water flow rate:

e.g. V = 1,000 l/h = 1,000 kg/h

Required spread:

$$\Delta T = \frac{10900\ W\,kg\,K\,h}{1{,}163\ Wh \cdot 1000\ kg} = 9{,}4\ K$$

8.3.2 Temperature spread in relation to the heat source temperature

The heat output of the heat pump depends on the heat source temperature. This is especially the case, when the outside air is used as the heat source.

The maximum temperature spread in relation to the heat source temperature can be found in the following tables.

Air-to-water heat pump

Heat source temperature		Max. temperature spread between heating flow and return flow
From	To	
-20 °C	-15 °C	4 K
-14 °C	-10 °C	5 K
-9 °C	-5 °C	6 K
-4 °C	0° C	7 K
1 °C	5 °C	8 K
6 °C	10 °C	9 K
11 °C	15 °C	10 K
16 °C	20 °C	11 K
21 °C	25 °C	12 K
26 °C	30 °C	13 K
31 °C	35 °C	14 K

Table 8.1: Outside air heat source (temperature can be read from the heat pump manager!), operation with 1 compressor

Brine-to-water heat pump

Heat source temperature		Max. temperature spread between heating flow and return flow
From	To	
-5 °C	0 °C	10 K
1 °C	5 °C	11 K
6 °C	9 °C	12 K
10 °C	14 °C	13 K
15 °C	20 °C	14 K
21 °C	25 °C	15 K

Table 8.2: Heat source: ground, operation with 1 compressor

Water-to-water heat pump

Heat source temperature		Max. temperature spread between heating flow and return flow
From	To	
7 °C	12 °C	10 K
13 °C	18 °C	11 K
19 °C	25 °C	12 K

Table 8.3: Heat source: Ground water, operation with 1 compressor

8.3.3 Overflow valve

In the case of systems with only one heating circuit and even volume flows in the consumer circuit, the main circuit (M13) heat circulating pump (see *Fig. 8.26 on p. 191*) can also be used to maintain the flow through the heat pump and the heating system.

If room temperature controllers are used, the radiator valves and thermostat valves could cause the volume flows in the consumer circuit to fluctuate. These volume flow fluctuations must be compensated for by an overflow valve installed in the heating bypass downstream from the unregulated heating pump main circuit (M13).

If there is an increasing drop in pressure in the consumer circuit (for example because valves are in the process of being closed) a partial volume flow is directed through the heating bypass, thus ensuring a minimum heating water flow rate through the heat pump.

NOTE

Electronically regulated circulating pumps which reduce the volume flow with increasing drops in pressure should not be used in combination with an overflow valve.

Overflow valve adjustment

- Close all of the heating circuits that may also be closed during operation (depending on the type of heat pump usage) so that the most unfavourable operating state - with respect to the water flow - is achieved. This normally means the heating circuits of the rooms on the south and west sides of the building. At least one heating circuit must remain open (e.g. bathroom).
- The overflow valve should be opened far enough to produce the maximum temperature spread between the heating flow and return flow listed in *Chap. 8.3.2 on p. 176* for the current heat source temperature. The temperature spread should be measured as close as possible to the heat pump.

NOTE

If an overflow valve is closed too tightly, the minimum heating water flow rate through the heat pump can not be guaranteed.
Conversely, if an overflow valve is open too wide, individual heating circuits might not have a sufficient flow rate.

8.3.4 Differential pressureless manifold

The minimum heating water throughput is maintained by the heat pump under all operating statuses (see *Fig. 8.27 on p. 191*) through the hydraulic isolation of the generator circuit from the consumer circuit.

Installation of a manifold without differential pressure is recommended for:

- Heating systems with radiators
- Heating systems with more than one heating circuit
- Unknown pressure drops in the consumer circuit (e.g. in existing buildings)

The main circuit (M13) heat circulating pump ensures the minimum heating water flow rate of the heat pump for all operating statuses without the need for manual settings.

Different volume flows in the heat generator and consumer circuits are balanced via the manifold without differential pressure. The pipe cross section of the manifold without differential pressure should have the same diameter as the heating system flow and return flow.

NOTE

The maximum flow temperature of the heat pump in the heating circuits will not be reached if the volume flow in the consumer circuit is higher than the the volume flow in the generator circuit.

8.3.5 Dual differential pressureless manifold

In a heat pump, the dual differential pressureless manifold is a useful alternative for the buffer tank connected in parallel, since it fulfils the same function without compromising when it comes to efficiency. The hydraulic isolation is realised using two differential pressureless manifolds with a check valve each (see *Fig. 8.28 on p. 192*).

Advantages of the dual differential pressureless manifold:

- Hydraulic isolation of the generator circuit and the consumer circuit
- Operation of the circulating pump (M16) in the generator circuit with the compressor in heating operation only, to avoid unnecessary operation
- Possibility for a joint use of the buffer tank connected in series by the heat pump and the additional heat generator
- Protection of the heat pump against too high temperatures when external energy is fed into the buffer tank connected in series
- Guarantee of the minimum compressor runtimes and defrosting in all possible operating conditions through full circulation of the buffer tank connected in series
- Interruption of the heating operation for the domestic hot water and swimming pool water preparation so that the heat pump is always operated with the lowest possible temperature level.

NOTE

The hydraulic integration via two dual differential pressureless manifolds offers maximum flexibility, operational safety and efficiency.

8.4 Hot Water Distribution System

The hot water distribution system consists of perfectly matched individual components which can be combined according to individual requirements. The maximum permissible heating water flow of each component must be taken into account during the dimensioning.

NOTE

The components of the hot water distribution system are shown in the integration diagrams in *Chap. 8.12 on p. 186* in dashed lines.

Buffer tank connection and assurance of heating water flow

- Compact manifold
  KPV 25 (recommended for up to 1.3 m^3/h)
- EB KPV differential pressureless manifold extension module
  (recommended for up to 2.0 m^3/h)
- Dual differential pressureless manifold
  DDV 32 (recommended for up to 2.5 m^3/h)

Heating distribution system module

- Unmixed heating circuit module
  WWM 25 (recommended for up to 2.5 m^3/h)
- Mixed heating circuit module
  MMH 25 (recommended for up to 2.0 m^3/h)
- Manifold bar for connecting two heating circuits
  VTB 25 (recommended for up to 2.5 m^3/h)

Domestic hot water distribution system module

- Hot water module
  WWM 25 (recommended for up to 2.5 m^3/h)

Manifold bar for KPV 25 and HHM 25 connection

VTB 25 (recommended for up to 2.5 m^3/h)

Extension modules for the distribution system

- Mixer module for bivalent systems
  MMB 25 (recommended for up to 2.0 m^3/h)
- Solar station for hot water
  SST 25

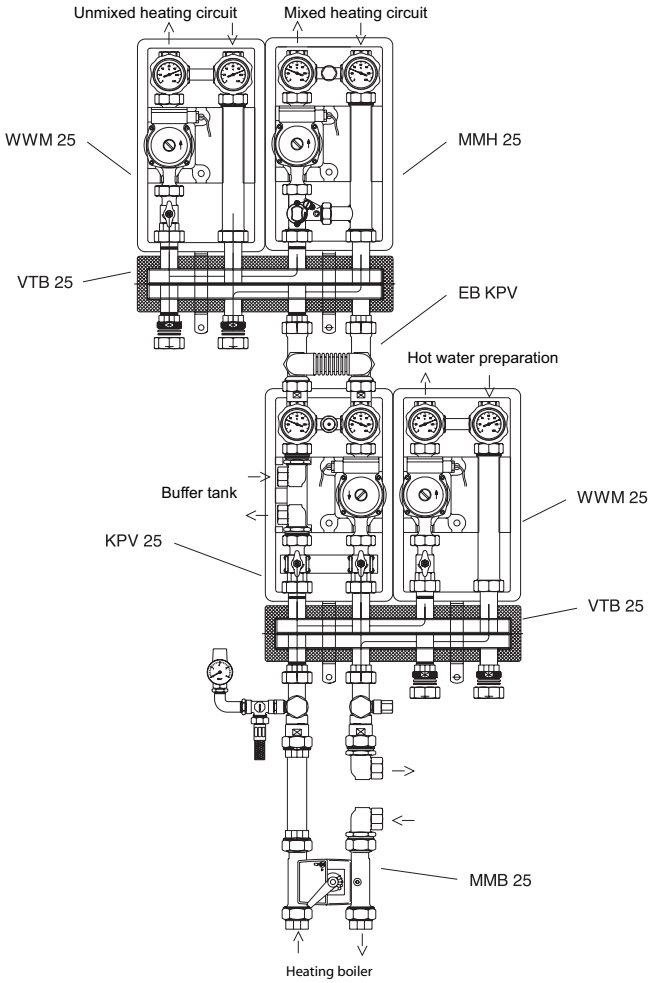


Fig. 8.2: Combination possibilities for the hot water distribution system

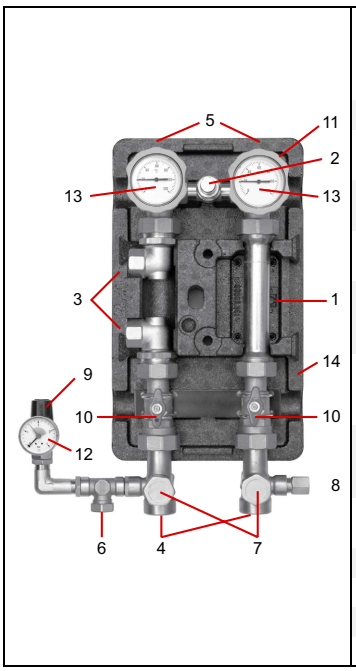
8.4.1 KPV 25 compact manifold

The compact manifold functions like an interface between the heat pump, the heating distribution system, the buffer tank and, in some cases, even the domestic hot water cylinder.

A compact system is used to simplify the installation process so that a lot of different components do not have to be installed individually.

NOTE

The use of the KPV 25 compact manifold with overflow valve is recommended for heating systems with panel heating and a heating water flow rate up to max. 1.3 m³/h.



1	Mounting position of heat circulating pump (not included in scope of supply)
2	Overflow valve
3	Buffer tank connections (1" internal thread)
4	Heat pump connections (1" internal thread)
5	Heating connections (1" internal thread)
6	Expansion vessel connection (¾" external thread)
7	Hot water heating connections (1"external thread)
8	Immersion sleeve for return flow sensor incl. cartridge fuse
9	Safety valve (¾" internal thread)
10	Stop-cock
11	Stop-cock with check valve
12	Thermometer
13	Shell insulation

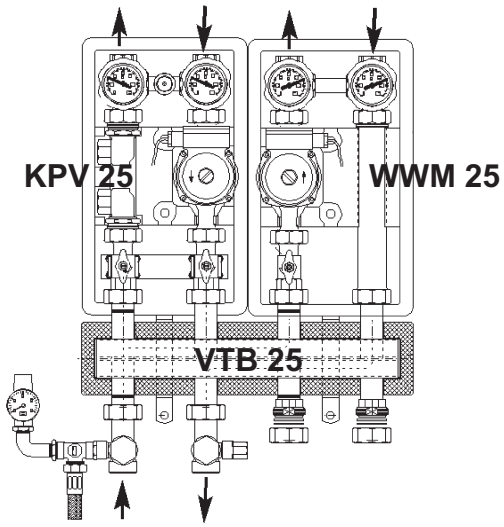


Fig. 8.3: KPV 25 compact manifold with VTB 25 manifold bar and WWM 25 domestic hot water module

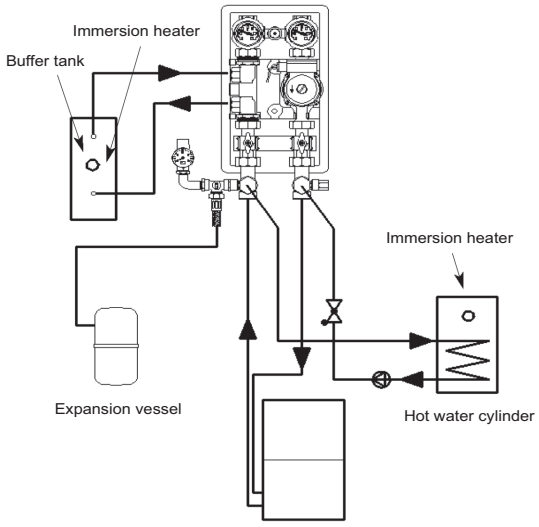


Fig. 8.4: Integration of the compact manifold for heating operation and domestic hot water preparation

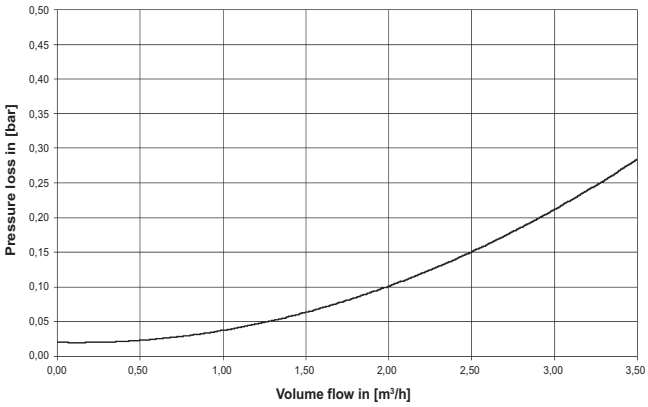


Fig. 8.5: KPV 25 pressure loss in relation to the volume flow

8.4.2 KPV 25 compact manifold with EB KPV extension module

The KPV 25 compact manifold can be turned into a differential pressureless manifold through the use of the EB KPV 25 extension module. The generator and consumer circuits are hydraulically isolated and they comprise on circulating pump each.

NOTE

The use of the KPV 25 compact manifold with EB KPV extension module is recommended for heat pumps with a heating water flow rate up to max. 2.0 m³/h.

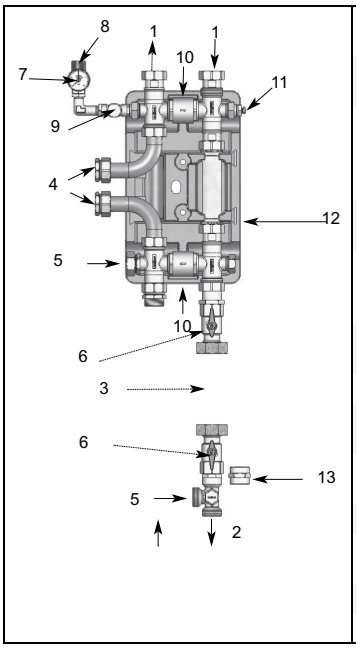
8.4.3 DDV 32 dual differential pressureless manifold

The DDV 32 dual differential pressureless manifold functions like an interface between the heat pump, the heating distribution system, the buffer tank and, in some cases, even the domestic hot water cylinder.

A compact system is used to simplify the installation process so that a lot of different components do not have to be installed individually.

NOTE

The use of the DDV 32 compact manifold is recommended for heat pumps with a heating water flow rate up to max. 2.5 m^3/h.



1	Heating connections 1 1/2“ internal thread
2	Heat pump connections 1 1/4" external thread
3	Auxiliary circulating pump/ Main circuit heat circulating pump 1 1/4" external thread
4	Buffer tank connections 1 1/4" internal thread
5	Hot water cylinder connections 1 1/4" external thread
6	Stop-cock with check valve
7	Pressure gauge
8	Safety valve 3/4“ internal thread
9	Tee joint for the mounting of the expansion module
10	Check valve
11	Immersion sleeve for return flow sensor
12	Insulation
13	Double nipples 1 1/4"

Fig. 8.6: DDV 32 dual differential pressureless manifold for the connection of the mixed heating circuit, external supplementary heating and optional domestic hot water preparation.

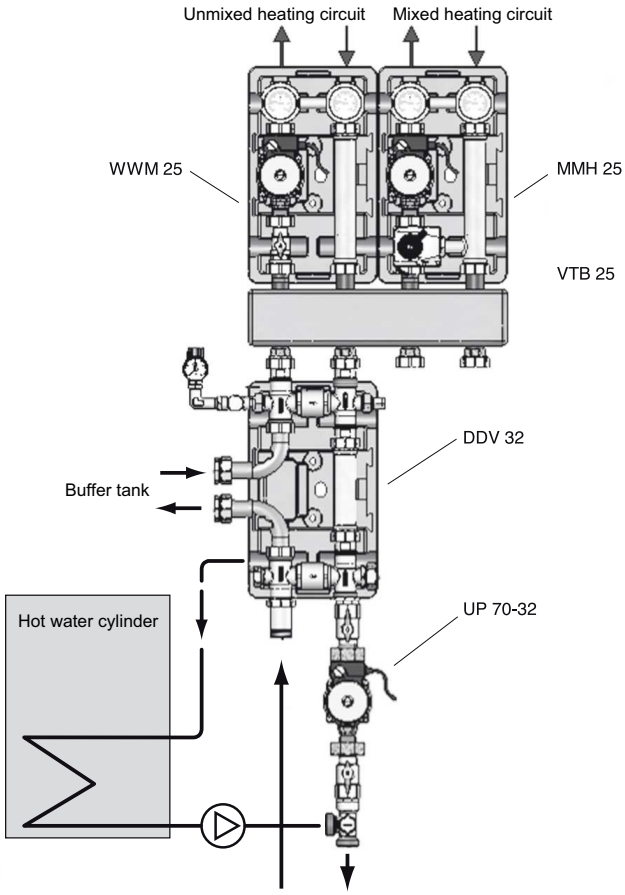


Fig. 8.7: Integration of the dual differential pressureless manifold for the heating operation and the domestic hot water preparation

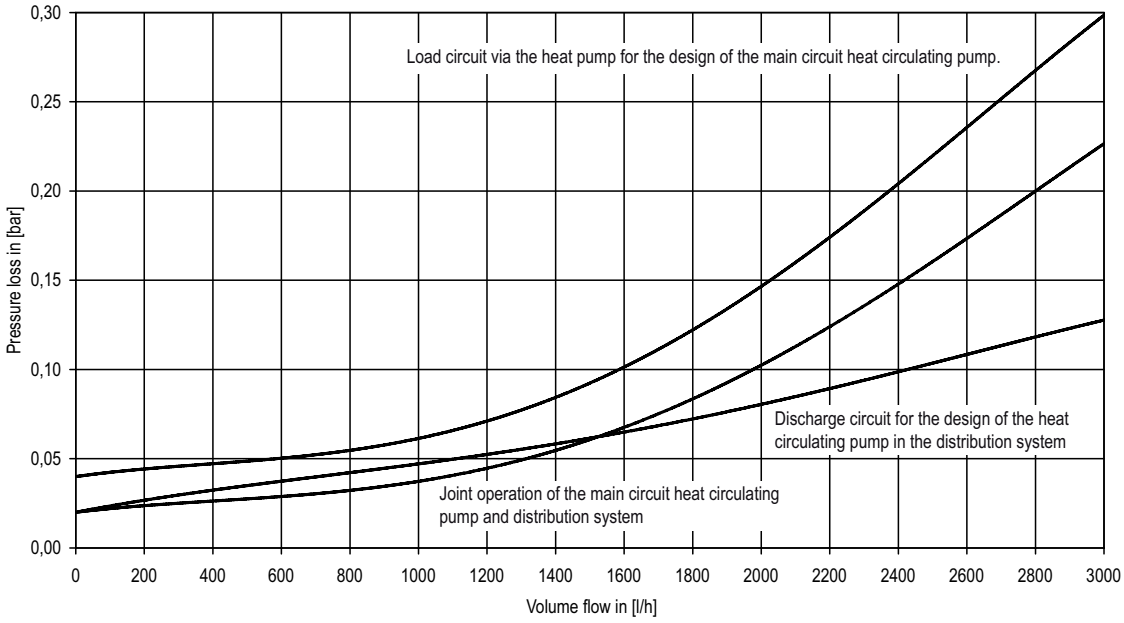


Fig. 8.8: Volume flow - pressure drop diagram DDV 32

8.5 Buffer Tank

A buffer tank connected in series is recommended for heat pump heating systems to ensure the minimum runtime of the heat pump of 6 minutes for all operating statuses.

Air-to-water heat pumps with defrosting by reverse circulation extract the energy required for defrosting from the heating system. In air-to-water heat pumps, a buffer tank connected in series must be installed in the flow in which the immersion heater is screwed into in mono energy systems to ensure defrosting.

NOTE

During the start-up of a air-to-water heat pump, the heating water must be pre-heated to the lower operating limit of at least 18°C to ensure defrosting.

ATTENTION!

An electric heating element which is fitted in a buffer tank must - as a heat generator - be protected by fuse according to EN 12828. It must also be additionally equipped with an expansion vessel that cannot be shut off as well as with a type-tested safety valve.

When implementing brine-to-water or water-to-water heat pumps, the buffer tank can be installed in the flow or, in a purely monovalent mode of operation, even in the return flow.

Buffer tanks connected in series are operated on the temperature level required by the heating system. They are not used for bridging shut-off times (see *Chap. 8.5.3 on p. 180*).

In heavily-constructed buildings and for the use of panel heating systems in general the sluggishness of the heating system compensates for possible shut-off times.

Heat pump manager timer functions offer the possibility to compensate for set shut-off times through programmed raises.

NOTE

The recommended capacity of the buffer tank connected in series is approximately 10% of the heating water flow of the heat pump per hour. A volume of approximately 8% is sufficient for heat pumps with two performance levels. However, it should not exceed 30 % of the heating water flow per hour.

Overdimensioned buffer tanks lead to longer compressor runtimes. In heat pumps with two performance levels this may lead to the unnecessary switching on of the second compressor.

ATTENTION!

Buffer tanks are not enamelled and, for this reason, should never be used for heating water for domestic use. Buffer tanks should be installed within the thermal envelope of the building in a completely frost-free location.

8.5.1 Heating systems with individual room control

With individual room control the required room temperature can be adjusted without changing the settings of the heat pump manager. If the room set temperature set at the room temperature controller is exceeded, the actuators close so that the heating water no longer flows through the overheated rooms.

If individual heating circuits are closed and the volume flow is thus reduced, part of the heating water flow flows through the overflow valve or the differential pressureless manifold. This causes the return temperature to rise and the heat pump to be switched off.

In systems with buffer tanks connected in series the heat pump switches off before all rooms have been sufficiently supplied. A renewed start-up of the heat pump is prevented on account of the utility requirement that a heat pump may only be switched on up to three times per hour.

In the case of systems equipped with a buffer tank, the increase in the return temperature is delayed due to the flow through the tank. No increased system temperatures arise if the tank is connected in series. This increase in circulated heating water volumes result in longer runtimes and an improved average efficiency over the whole year (annual performance factor).

NOTE

The buffer tank connected in series increases the circulated heating water volume and guarantees the operational safety even when only individual rooms require heating.

8.5.2 Heating systems without individual room control

If brine-to-water or water-to-water heat pumps are used in systems **without any controllers in the individual rooms**, the buffer tank can be omitted if the individual heating circuits are sufficiently dimensioned so that minimum compressor runtime of approx. 6 minutes is also ensured in interseasonal transition periods with low heat consumption.

NOTE

If there is no individual room control in the living quarters, a more or less consistent temperature level is reached within the thermal envelope of the building. The heating of individual rooms on a higher temperature level (e.g. bathroom) can partly be achieved through a hydraulic equalisation.

8.5.3 Buffer tank for bridging shut-off times

An additional buffer tank, equipped with a second heat generator and acting as a constantly-regulated buffer tank, is recommended for installed for the use of heat pumps and in combination with radiators in lightly-constructed buildings (due to small tank capacities). The buffer tank is heated up in combination with the special program heat generator 2 (heat pump manager) according to need. This mixer regulation is activated when the second heat generator is called during a shut-off time. The electric heating element should be set to approx. 80 to 90°C.

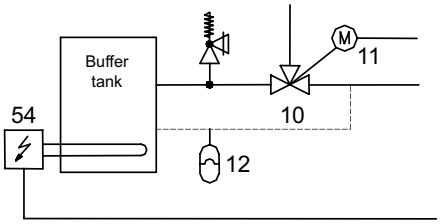


Fig. 8.9: Heating operation with constantly-regulated buffer tank

Dimensions and weights	Unit	PSW 100	PSP 100E	PSP 140E	PSW 200	PSW 500
Nominal volume	l	100	100	140	200	500
Diameter	mm	512			600	700
Height	mm	850	550	600	1300	1950
Width	mm		650	750		
Depth	mm		653	850		
Heating water return flow	Inch	1“ internal thread	1¼“ external thread	1“ external thread	1¼“ internal thread	2 x 2½“
Heating water flow	Inch	1“ internal thread	1¼“ external thread	1“ external thread	1¼“ internal thread	2 x 2½“
Permissible operating overpressure	Bar	3	3	3	3	3
Maximum tank temperature	°C	95	95	95	95	95
Supporting feet (adjustable)	Item			4	3	3
Heating element inserts (1 ½“ internal thread)	Number	2	1	2	3	3
Max. heat output per heating element	kW	4,5	7,5	9	6	7,5
DN 180 flange	Number					1
Weight	kg	55	54	72	60	115

Table 8.4: Technical data of the buffer tank

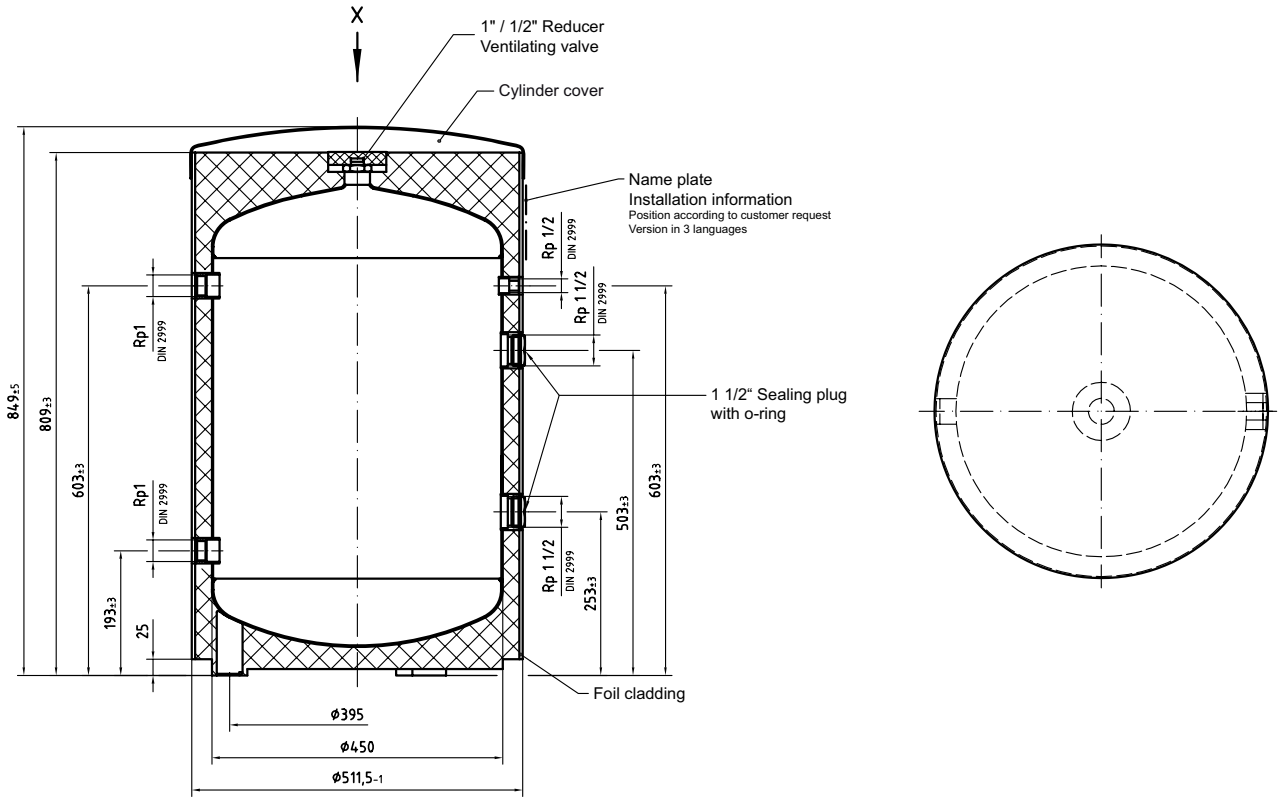


Fig. 8.10: Dimensions of the floor-mounted buffer tank PSW 100 (see also *Table 8.4 on p. 181*)

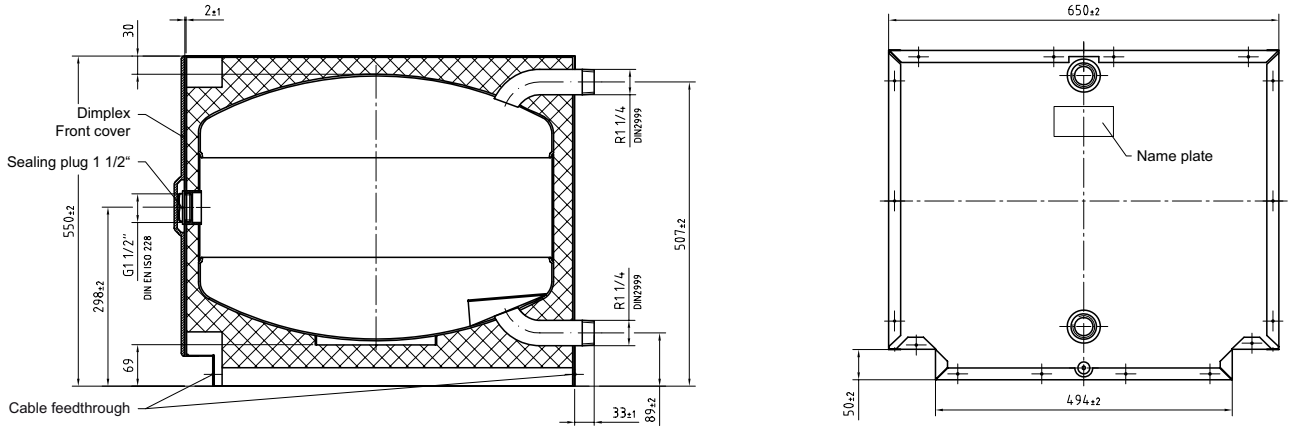


Fig. 8.11: Dimensions of the PSP 100E built-under buffer tank for the compact brine-to-water heat pump (see also *Table 8.4 on p. 181*)

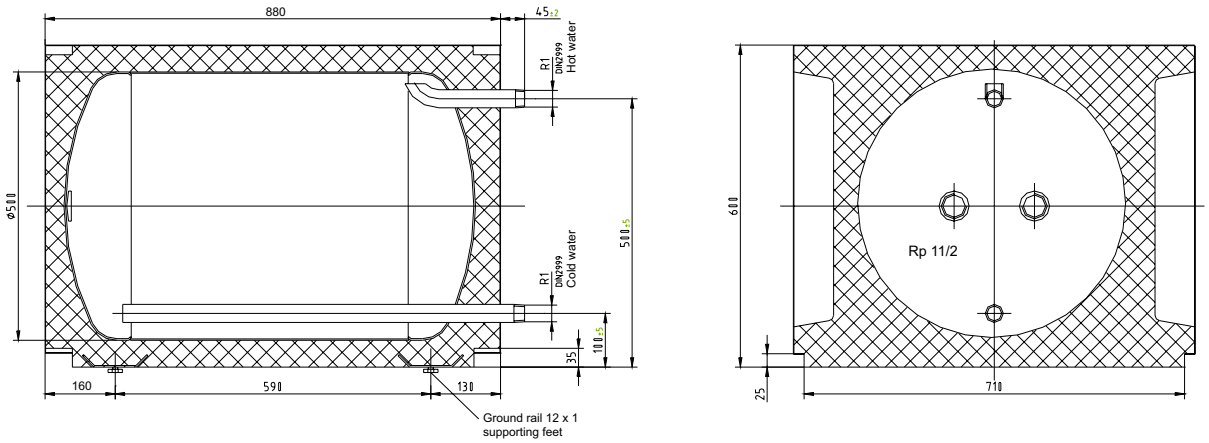


Fig. 8.12: Dimensions of the PSP 140E built-under buffer tank for air-to-water heat pumps installed indoors (see also *Table 8.4 on p. 181*)

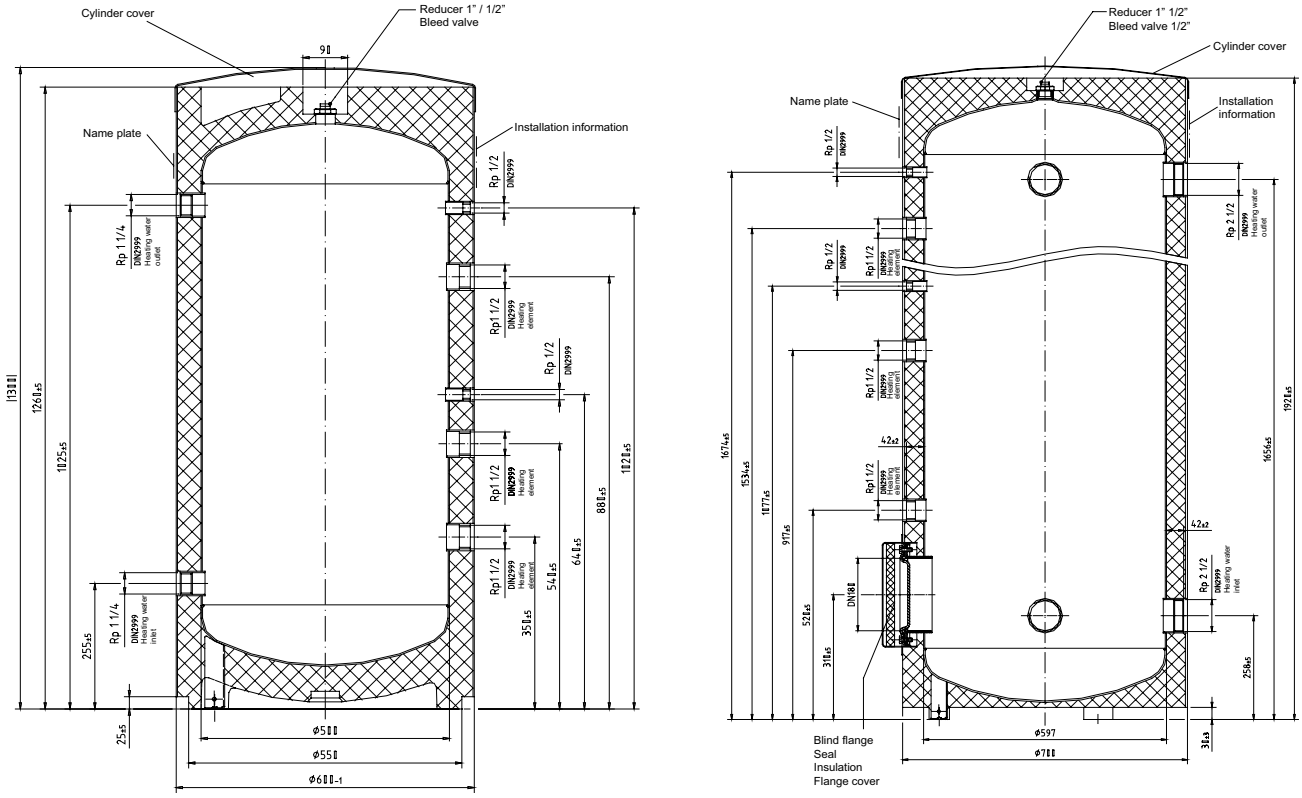


Fig. 8.13: Dimensions of the 200 l and 500 l buffer tanks (see also *Table 8.4 on p. 181*)

8.5.4 Expansion vessel / safety valve in the heat pump circuit

When water is heated up, there is an increase in pressure in the heat pump circuit (due to the expansion of the heating water) which must be compensated for by the expansion vessel. Dimensioning is dependent on the heating water volume and the maximum system temperatures.

An impermissibly high pressure can build up in the heating system when the system is being filled or the water is being heated. This excess pressure must be discharged via a safety valve according to EN 12828.

Bivalent systems

The expansion vessel and safety valve integrated in the boiler circuit is ineffective if the mixer is closed tightly. For this reason, each heat generator must be equipped with a separate safety valve and expansion vessel. These are dimensioned according to the total volume of the system (heat pump, cylinder, radiators, pipework, boiler).

8.5.5 Check valve

If a water circuit contains more than one circulating pump, each pump unit must be equipped with a check valve to prevent mixing from other heating circuits. It should be ensured that check valves close tightly and are noiseless during flow through.

NOTE

Dirt particles can prevent the valves from fully closing. This could, for example, lead to insufficient domestic hot water temperatures and swimming pool temperatures if cold heating water is added during domestic hot water preparation and swimming pool heating.

8.6 Flow Temperature Limit of Underfloor Heating

Many underfloor heating pipes and screed floorings should not be heated over 55 °C. In the case of bivalent operation or if the buffer tank is charged externally, a limitation of the flow temperature must be effected to prevent such overheating.

NOTE

With a mixer in the underfloor heating circuit or in bivalent-renewable operating mode, the mixer is closed when the temperatures are too high. A safety temperature monitor prevents increased system temperatures due to mixer sluggishness or failure.

8.6.1 Flow temperature limiting via a mixer limit switch

The mixer is only opened so wide at full boiler output and maximum boiler temperature that the maximum flow temperature of approx. 55 °C is not exceeded. A further mixer open command is prevented by locking the freely controllable mixer limit switch in this position.

We recommend installing a mixer motor equipped with a limit switch so that the drive can be switched off electrically.

8.6.2 Flow temperature limiting using mixer bypass

At full boiler output, maximum boiler temperature and with the mixer opened completely, the bypass is opened so wide that the maximum flow temperature is not exceeded. This limits the flow temperature. The regulator valve must be secured against accidental adjustment.

We recommend using mixers equipped with an internal bypass.

This type of flow temperature limiting is particularly suitable for underfloor heating.

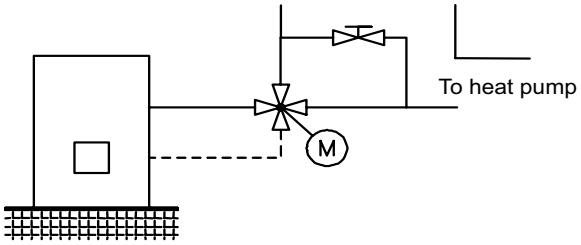


Fig. 8.14: Bypass circuit for safeguarding the maximum flow temperature

8.7 Mixer

The mixer is in the “closed” position (for the boiler) in heat pump only operation and directs the hot flow water past the boiler. This prevents downtime losses. The mixer is dimensioned according to the boiler output and the flow rate volume.

The mixer drive must have a runtime of between 1 and 6 minutes. The heat pump manager controls the mixer and can be set to this runtime. We recommend using mixers with a runtime of between 2 and 4 minutes.

8.7.1 Four-way mixer

The four-way mixer is generally required for oil boilers with fixed temperature regulation. These may not be operated below temperatures of 70 °C (poss. 60 °C). The four-way mixer mixes the boiler temperature to match the currently required flow temperature. Using the effect of an injector, the four-way mixer maintains a circulation in the boiler circuit which flows in the opposite direction of the heating system circuit. This ensures that the heating water returning to the boiler is always hot enough to prevent the dew point in the boiler from being undershot (which in turn would cause the return flow temperature to rise).

8.7.2 Three-way mixer

The three-way mixer is used to regulate individual heating circuits and is also implemented when low-temperature boilers or condensing boilers with burner regulation are used (e.g. “variably-regulated boilers”). These types of boilers can have cold return flow water circulating through them. The three-way mixer thus serves as a kind of switching valve. It is completely closed in heat pump only operation (prevents downtime losses) and is completely open in boiler operation.

8.7.3 Three-way solenoid valve (switching valve)

Three-way solenoid valves are not to be recommended for this application because they do not function reliably and can transmit sound to the heating system.

8.8 Contaminants in the Heating System

When installing a heat pump in a new or existing heating system, the system should be flushed to remove deposits and suspended matter. These types of contaminants can reduce the heat transfer of the radiators, impede the flow or collect in the condenser of the heat pump. In extreme cases, they can cause the heat pump to switch off automatically. Oxidation products (rust) can form if oxygen enters the heating water. Contamination caused by remnants of organic lubricants and gasket material can also occur frequently. Both sources of contamination can lead - either individually or together - to a reduction in the efficiency of the heat pump's condenser. In such cases, the condenser must be cleaned.

Detergents should only be used with caution because of their high acid content. The regulations of relevant employers' liability insurance associations should be observed. Always consult the manufacturers of the chemicals in case of doubt!

⚠ ATTENTION!

The heating system should be neutralized with suitable chemicals after cleaning to avoid consequential damage.

The heat pump should generally be disconnected from the heating system before flushing. Shutoff valves should be fitted in the flow and return flow to prevent the heating water from leaking. The water connections on the heat pump are used for flushing.

In the case of heating systems equipped with steel components (e.g. pipes, buffer tank, boiler, manifold, etc.), there is always the danger of excess oxygen causing corrosion. This oxygen enters the heating system via the valves, the circulating pumps and/or plastic pipes.

i NOTE

We therefore recommend equipping diffusion-open heating system with an electrophysical anti-corrosion system. According to today's state of knowledge, an ELYSATOR system is well suited for this kind of use.

8.9 Integration of Additional Heat Generators

8.9.1 Constantly regulated boiler (mixer regulation)

When implementing this type of boiler, the boiler water is always heated to a set temperature (e.g. 70 °C) when the command is issued accordingly by the heat pump manager. This temperature must be set so high that domestic hot water preparation can also be carried out using the boiler according to need.

Regulation of the mixer is undertaken by the heat pump manager. If required, it calls for the boiler and adds more hot water until the desired set return temperature or hot water temperature is reached.

The boiler is called via the 2nd heat generator output of the heat pump manager and the mode of operation of the 2nd heat generator is coded as being “constant".

i NOTE

When the special program heat generator 2 is activated, the boiler is maintained at operating temperature for at least 30 hours after the command is issued to prevent corrosion caused by short runtimes.

8.9.2 Variably-Regulated Boiler (Burner Regulation)

In contrast to the constantly-regulated boilers, variably-regulated boilers supply hot water at a temperature which is directly based on the respective external temperature. The three-way reversing valve has no regulatory function. However, it has the task of directing the hot water flow past or through the boiler, depending on the operating mode. In the case of heat pump only operation, the heating water is directed past the boiler to avoid losses caused by heat dissipation of the boiler. No separate burner regulation is required for bivalent systems because control can be undertaken by the heat pump manager. If the system is equipped with atmospherically controlled burner regulation, the voltage supply for burner regulation should be disconnected in the case of heat pump only operation. The boiler is controlled via the 2nd heat generator output of the heat pump manager, and the mode of operation of the 2nd heat generator is coded as being “variable”. The characteristic curve of the burner regulation is set according to the heat pump manager.

i NOTE

It is not possible to control an additional immersion heater for supplementary heating (E10.1) in a bivalent system.

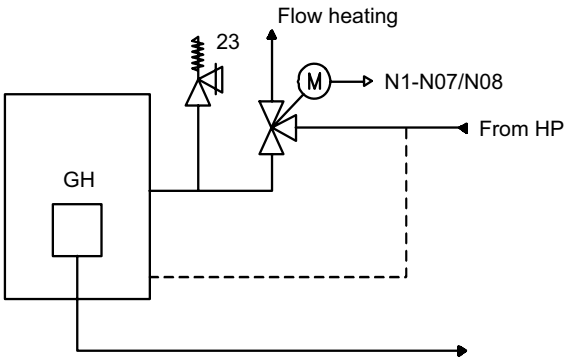


Fig. 8.15: Circuit diagram for variably-regulated boiler operation

8.9.3 Renewable heat sources

The heat pump manager has a separate operating mode for the integration of renewable heat sources such as solid fuel boilers or thermal solar energy systems. The “Bivalent-renewable” operating mode can be chosen during the preconfiguration. In this operating mode the heat pump heating system responds like a mono energy system; when heat is supplied by the renewable heat source, the heat pump is automatically blocked and the heat generated by the renewable heat source is mixed into the heating system. The mixer outputs of the bivalence mixer (M21) are active.

If the temperature in the renewable cylinder is high enough, the heat pump is also blocked during domestic hot water preparation or swimming pool needs.

Heat pumps which are not equipped with a flow sensor (R9) must be retrofitted In reversible heat pumps or heat pump heating systems with a third heating circuit “Bivalent-renewable” is not available since the sensor (R13) is already in use.

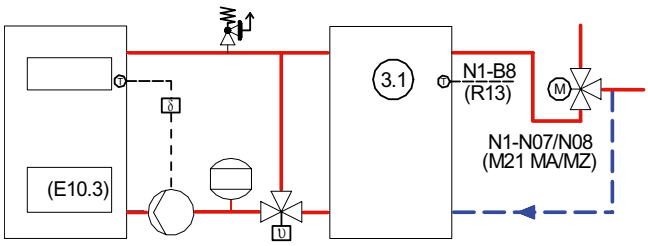


Fig. 8.16: Circuit diagram for heating operation with a solid fuel boiler

8.10 Heating a Swimming Pool

Swimming pool heating is integrated parallel to the heating and hot water heat pump. The swimming pool is heated by means of a swimming pool heat exchanger (see *Fig. 8.41 on p. 199* for hydraulic integration).

A	Filter
B	Filter pump
C	Swimming pool controller (thermostat)
D	Timer
M19	Swimming pool pump
RBG	Relay module

We recommend controlling the swimming pool heating via a time switch. The heating requirements of the swimming pool should only be forwarded to the heat pump manager if the swimming pool pump (M19) is running and the filter pump is switched on.

The transmission capacity of the heat exchanger must be based on the specific features of the heat pump, e.g. max. flow temperature of 55 °C and the minimum heating water throughput of the heat pump.

Not only the nominal output, but also the construction, the flow rate through the heat exchanger and the thermostat setting are important criteria for making a selection. The design temperature of the pool (e.g. 27 °C) and the flow rate in the pool circuit should also be taken into account when dimensioning the system.

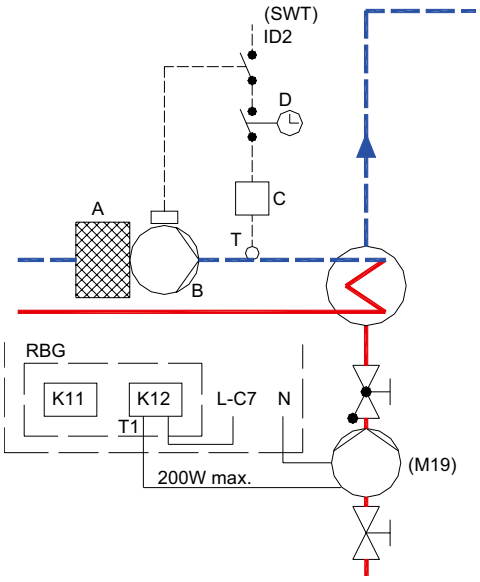


Fig. 8.17: Integration of swimming pool heating with heat pumps

8.11 Constant-Regulated Tank Charging

Two buffer tank thermostats and one contactor (2 contacts) are necessary for regulation of buffer tanks with large volumes which are to be charged with a constant temperature.

NOTE

The illustrated circuit ensures full charging of the buffer tank and in this way prevents the heat pump from surging.

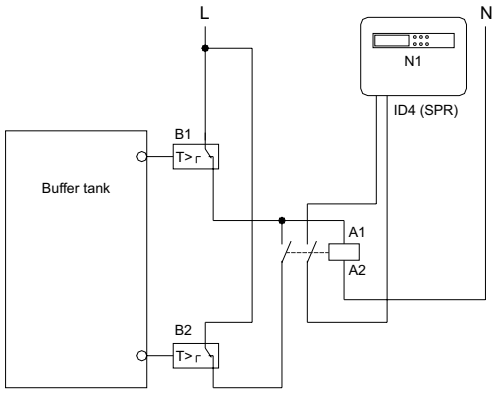


Fig. 8.18: Regulation for constantly-regulated tank charging

8.12 Hydraulic Integration

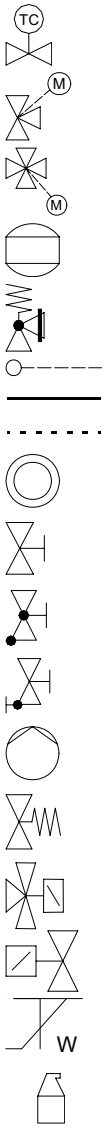
The heating system control is nearly identical for air-to-water, brine-to-water and water-to-water heat pumps, however, the hydraulics for the integration of the heat source are different.

The integration diagrams shown on the following pages show standard solutions for the most common applications. The heat pump manager controls the individual components. The diagrams show the contacts and the hydraulic components of the hot water distribution system (in dashed lines). The max. permissible heating water flow must be adhered to (see *Chap. 8.4 on p. 177*).

Additional integration diagrams can be downloaded from the Internet at www.dimplex.de.

Legend

1.	Heat Pump
1.1	Air-to-water heat pump
1.2	Brine-to-water heat pump
1.3	Water-to-water heat pump
2	Heat pump managers
3.	Buffer tank connected in series
3.1	Renewable cylinder
4.	Hot water cylinder
5.	Swimming pool heat exchanger
13.	Heat source
14.	Compact manifold
E9	Flange heater
E10	2nd heat generator (HG2)
E10.1	Electric heating element
E10.2	Oil/gas boiler
E10.3	Solid fuel boiler
E10.4	Main cylinder (water)
E10.5	Solar energy system
K20	Contactor for 2nd heat generator
K21	Contactor for immersion heater hot water
N1	Heating controller
N12	Solar controller (not included in the scope of supply of
M11	Heat source primary pump
M13	Heat circulating pump
M15	Heat circulating pump for heating circuit 2
M16	Auxiliary circulating pump
M18	Hot water circulating pump
M19	Swimming pool water circulating pump
R1	External wall sensor
R2	Return flow sensor
R3	Hot water sensor
R5	Sensor for heating circuit 2
R9	Flow sensor
R12	Defrost end sensor
R13	Sensor for heating circuit 3
TC	Room temperature controller
EV	Electrical distribution system
KW	Cold water
HW	Domestic hot water
MA	Mixer OPEN
MZ	Mixer CLOSED



Thermostat-controlled valve

Three-way mixer

Four-way mixer

Expansion vessel

Safety valve combination

Temperature sensor

Flow

Return flow

Heat consumer

Shutoff valve

Shutoff valve with check valve

Shutoff valve with drainage

Circulating pump

Overflow valve

Three-way reversing valve with actuator

Two-way valve with actuator

Safety temperature monitor

Large-capacity breather with micro air bubble deposition

NOTE

The following is a schematic representation of the key components for hydraulic integration and serves as an aid for planning a customized system.

It does not contain all the required safety devices, components needed to maintain constant pressure and any other additional valves which may be required for maintenance and service work as stipulated by EN 12828.

8.12.1 Integration of the heat source

The heat source primary pump M11 transports the recovered environmental heat to the evaporator of the heat pump. In air-to-water heat pumps this task is carried out by the integrated ventilator.

The integration of the ground or ground water as heat source can be seen in the following figures.

Ground as heat source

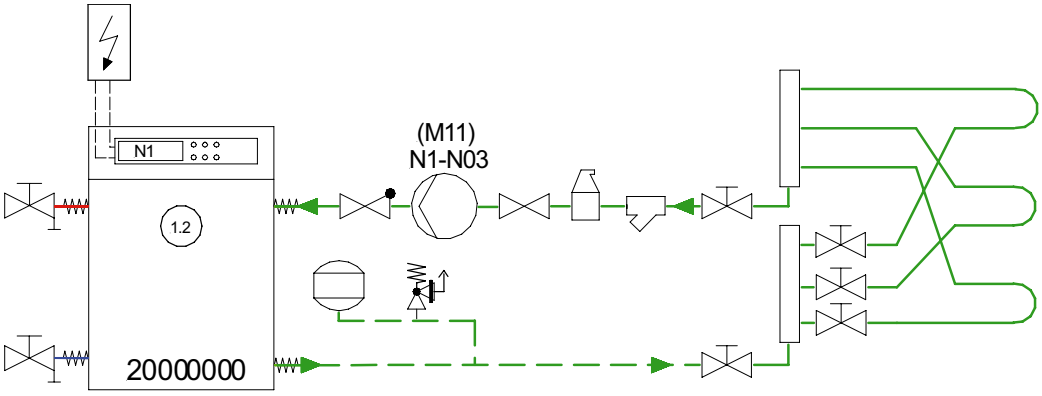


Fig. 8.19: Schematic representation of brine-to-water heat pumps

Every brine circuit should be provided with a shutoff valve for ventilation.
All the brine circuits must be of the same length to ensure that each has an equal flow and abstraction capacity.
The filling and breather mechanisms should be installed at the site's highest point.
A large-capacity breather should be installed at the highest and warmest possible point of the brine circuit.
The brine circulating pump of the heat source system should preferably be installed outside the building and protected against rain.

The pump should be insulated with steam-resistant material when installed inside a building to prevent the formation of condensate and ice. Sound insulating measures may also be necessary.

Ground water as heat source

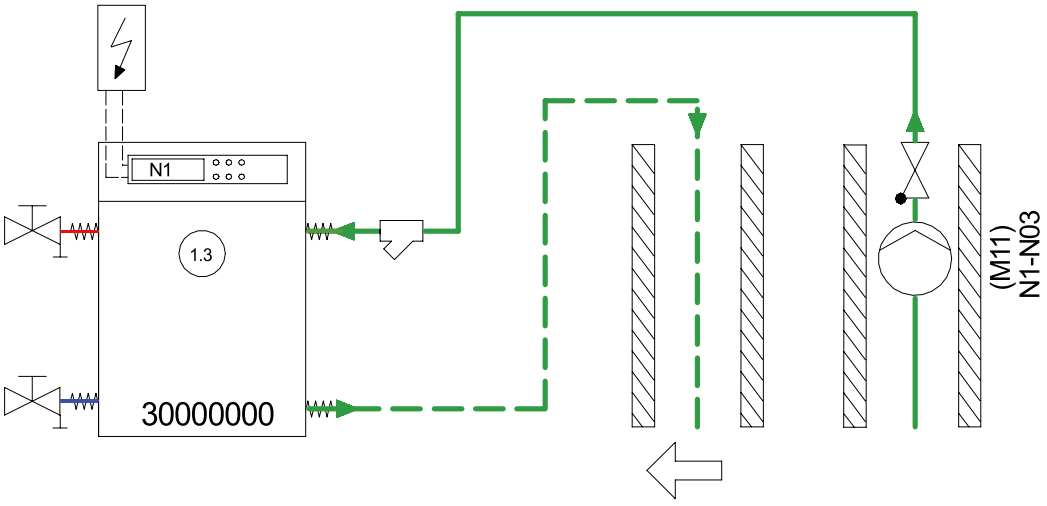


Fig. 8.20: Schematic representation of water-to-water heat pumps

Legend:

Two wells are required for the withdrawal of ground water, an “extraction well” and an “absorption well”. The absorption well must in the direction of ground water flow. The underwater pump and wellheads should have an airtight seal.

1.2 Brine-to-water heat pump
1.3 Water-to-water heat pump
M11 Primary pump for brine or ground water
N1 Heat pump manager Heating

8.12.2 Monovalent brine-to-water heat pump

A heating circuit with overflow valve

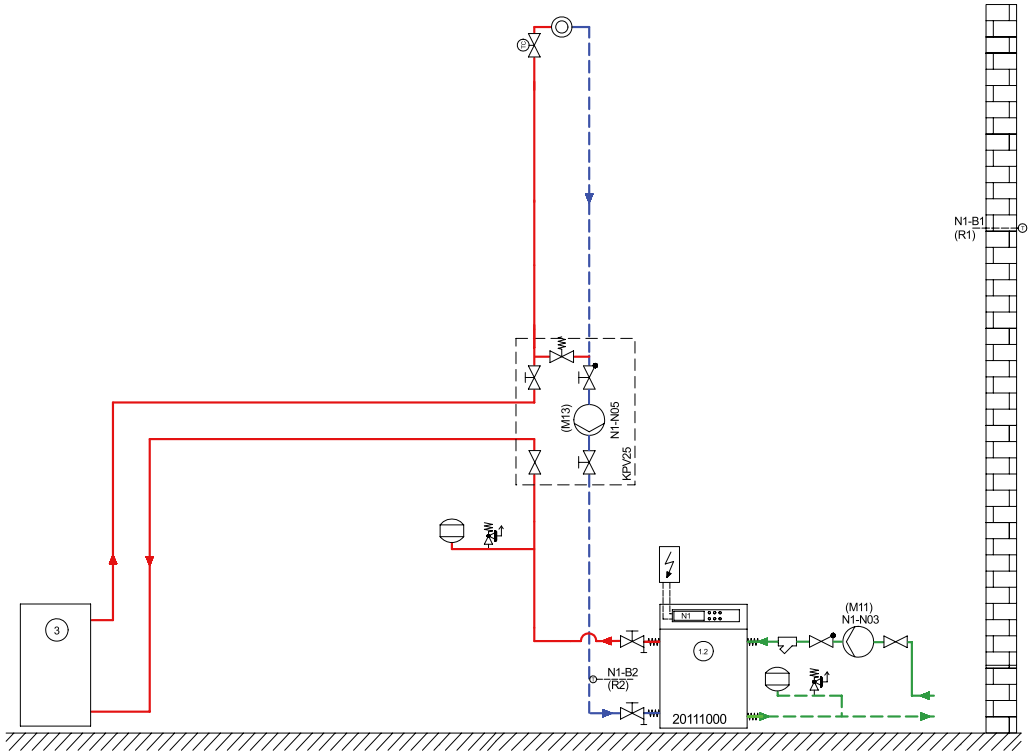


Fig. 8.21: Integration diagram for monovalent heat pump operation with one heating circuit and buffer tank connected in series (a minimum buffer tank volume of 10 % of the minimum throughput must be ensured either by a buffer tank connected in series or other suitable measures see *Chap. 8.5 on p. 180*)

Preconfiguration	Setting
Operating mode	Monovalent
1. Heating circuit 1	Yes
2. Heating circuit 1	No
Cooling function passive	No
Hot water preparation	No
Swimming pool preparation	No

In systems which are not equipped with controllers in the individual rooms (TC), the overflow valve must be adjusted - in combination with an unregulated heating pump (M13) - so that the minimum heating water flow rate is ensured for all possible operating conditions. The buffer tank connected in series increases the circulated volume and guarantees the minimum runtimes required by the compressor when only individual rooms require heating (for example, the bathroom).

Two heating circuits with differential pressureless manifold

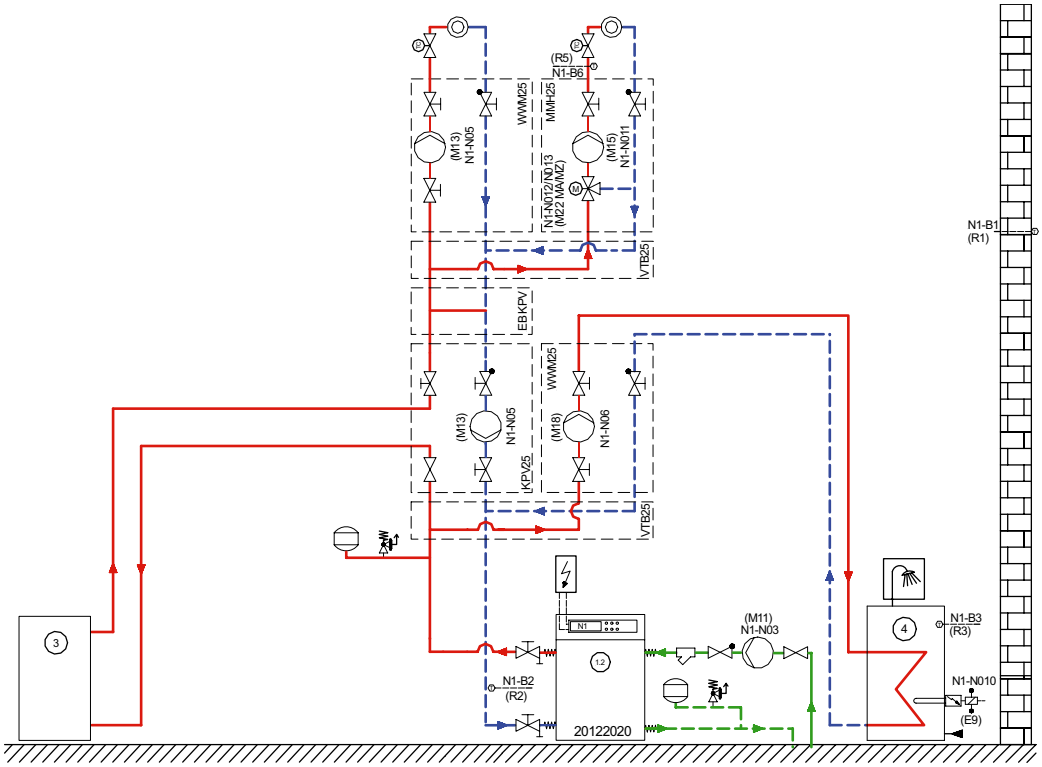


Fig. 8.22: Integration diagram for monovalent heat pump operation with two heating circuits, one buffer tank connected in series and hot water heating

Preconfiguration	Setting
Operating mode	Monovalent
1. Heating circuit 1	Yes
2. Heating circuit 1	Yes
3. Heating circuit 1	No
Cooling function passive	No
Hot water preparation	Yes
Request	Sensors
Flange heater	Yes
Swimming pool preparation	No

If there is more than one heating circuit, the generator and consumer circuits must be hydraulically isolated.

The differential pressureless manifold ensures the heating water flow and must have the same cross section as the flow and return lines.

Electrical connection of monovalent heat pump heating systems

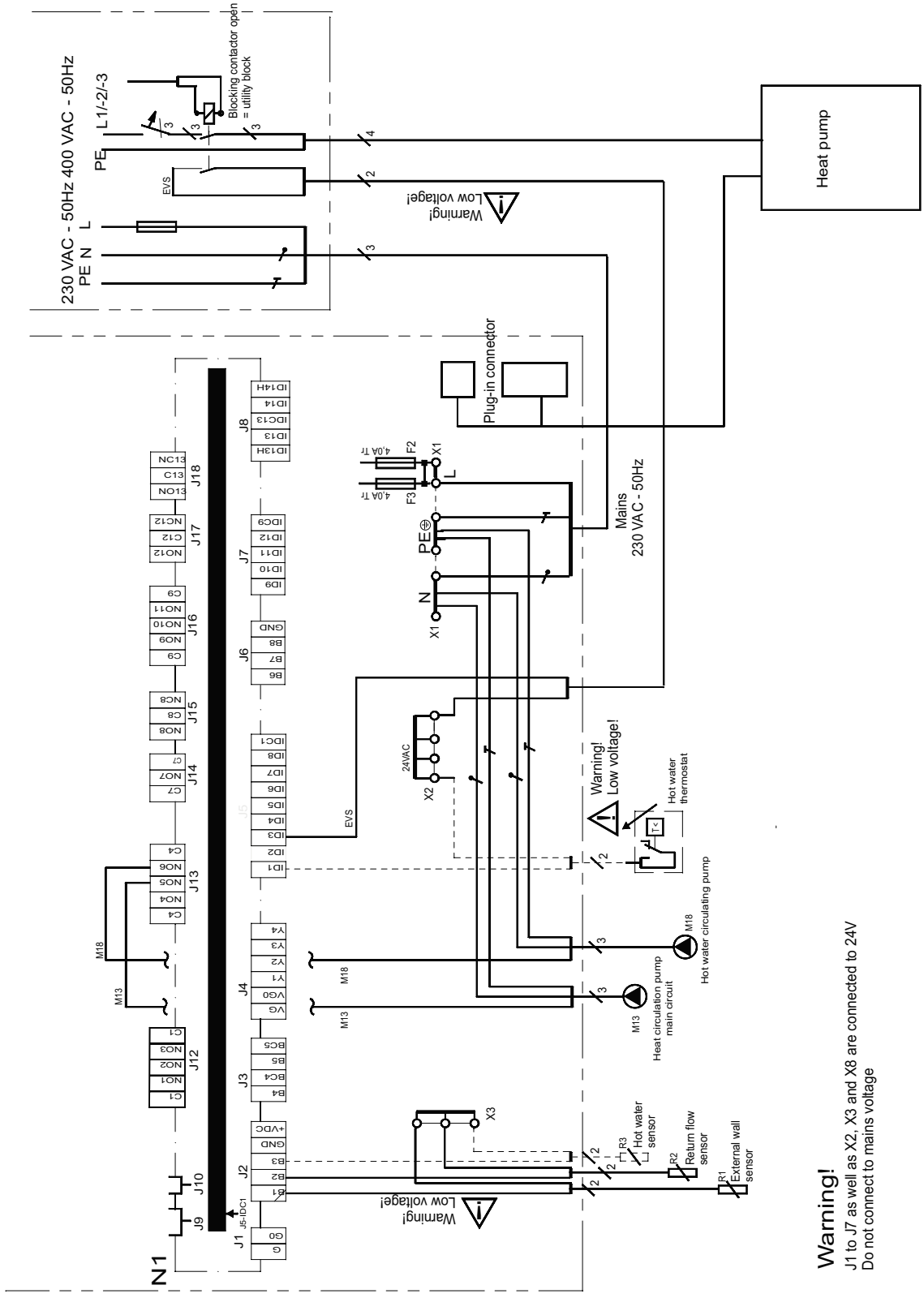


Fig. 8.23: Wiring diagram of a wall-mounted heat pump manager for a monovalent system with one heating circuit and domestic hot water preparation

The four-core supply cable for the output section of the heat pump is fed from the heat pump meter via the utility company's contactor (if required) into the heat pump (3L/PE~400V,50Hz). The system must be protected according to the power consumption data on the type plate using a 3-pole miniature circuit breaker with C characteristic and common tripping for all 3 paths. Cable cross section in compliance with DIN VDE 0100.

The three-core supply cable for the heat pump manager (N1 heat pump controller) is fed into the heat pump (device with integrated controller) or to the future mounting location of the wall-mounted heat pump manager (WPM). The (L/N/PE~230 V, 50 Hz) supply cable for the heat pump manager must have a constant voltage. For this reason, it should be tapped upstream from the utility blocking contactor or be connected to the household current, because otherwise important protection functions could be lost during a utility block.

8.12.3 Heat pumps in compact design

Compact air-to-water heat pump

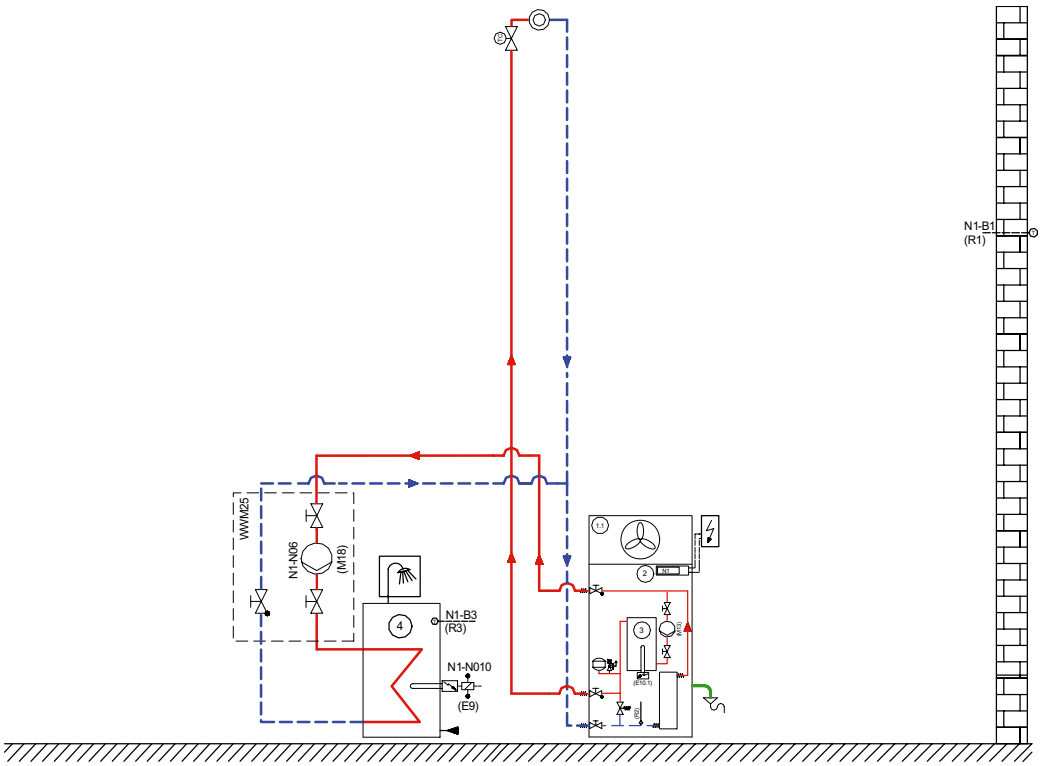


Fig. 8.24: Integration diagram for mono energy heat pump operation with one heating circuit and integrated buffer tank connected in series

Preconfiguration	Setting
Operating mode	Mono energy
1. Heating circuit 1	Yes
2. Heating circuit 1	No
Hot water preparation	Yes
Request	Sensors
Flange heater	Yes
Swimming pool preparation	No

The system components for the heat source and an unmixed heating circuit are integrated in a heat pump in compact design.

Domestic hot water preparation is optional.

If required, the 2 kW immersion heater integrated into the compact air-to-water heat pump can be replaced by a pipe assembly.

Integration diagrams are clearly marked through an 8-digit code (e.g. 12211020).

Compact brine-to-water heat pump

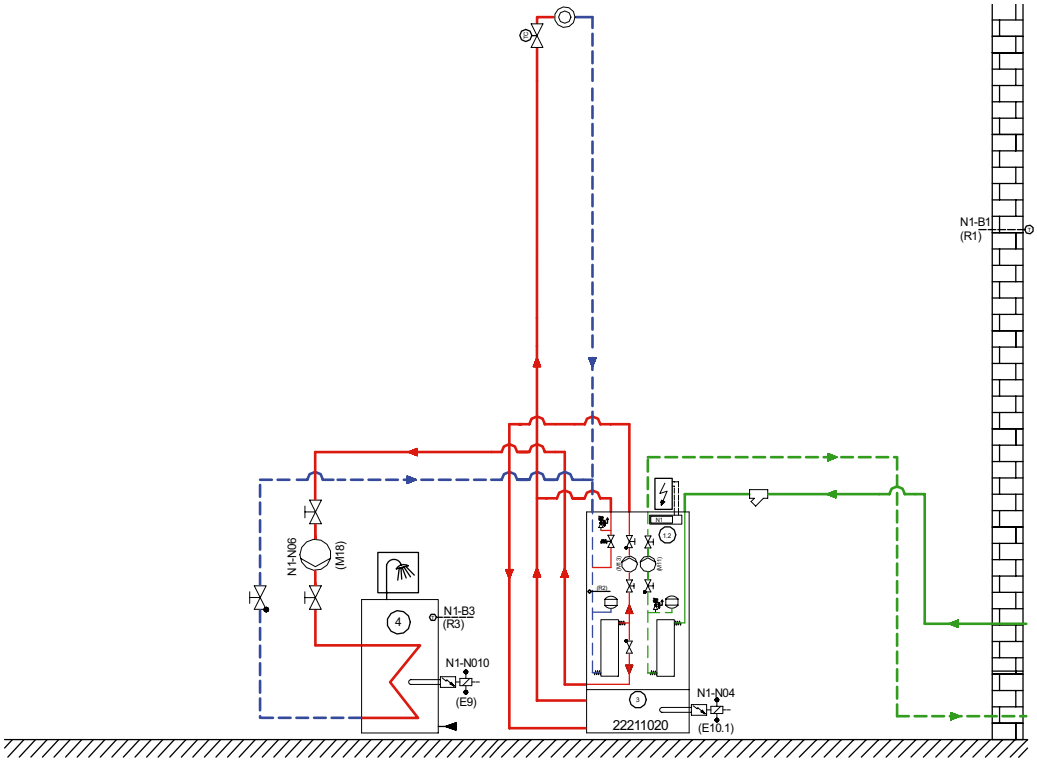


Fig. 8.25: Integration diagram for mono energy heat pump operation with one heating circuit and built-under buffer tank

Preconfiguration	Setting
Operating mode	Mono energy
1. Heating circuit 1	Yes
2. Heating circuit 1	No
Hot water preparation	Yes
Request	Sensors
Flange heater	Yes
Swimming pool preparation	No

The compact brine-to-water heat pump can be directly connected to the heating system due to the integrated solid-borne sound insulation.

The free compression of the integrated brine circulating pump is set for a maximum heat exchanger depth of 80 m (DN 32). For a greater heat exchanger depth the free compression must be checked and, if necessary, a DN 40 pipe must be used.

NOTE

Heat pumps in compact design can not be used for bivalent systems.

8.12.4 Mono energy heat pump heating system

A heating circuit with overflow valve

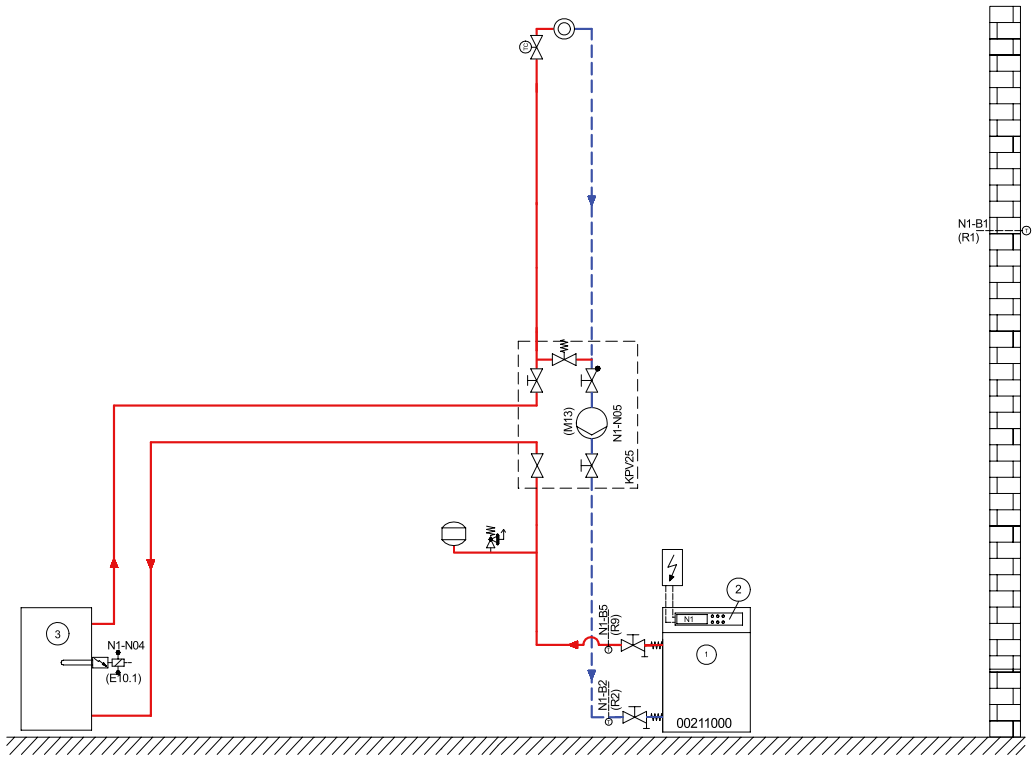


Fig. 8.26: Integration diagram for mono energy heat pump operation with one heating circuit and buffer tank connected in series

Preconfiguration	Setting
Operating mode	Mono energy
1. Heating circuit 1	Yes
2. Heating circuit 1	No
Hot water preparation	No
Swimming pool preparation	No

The heating water flow must be ensured using an overflow valve that must be set by the technician during start-up (see*Chap. 8.3 on p. 175*)

The use of the KPV 25 compact manifold with overflow valve is recommended for heating systems with panel heating and a heating water flow rate up to max. 1.3 mm^3/h.

If electric heating is installed in the buffer tank, it should be protected as a heat generator according to DIN EN 12828.

Heating circuit with differential pressureless manifold

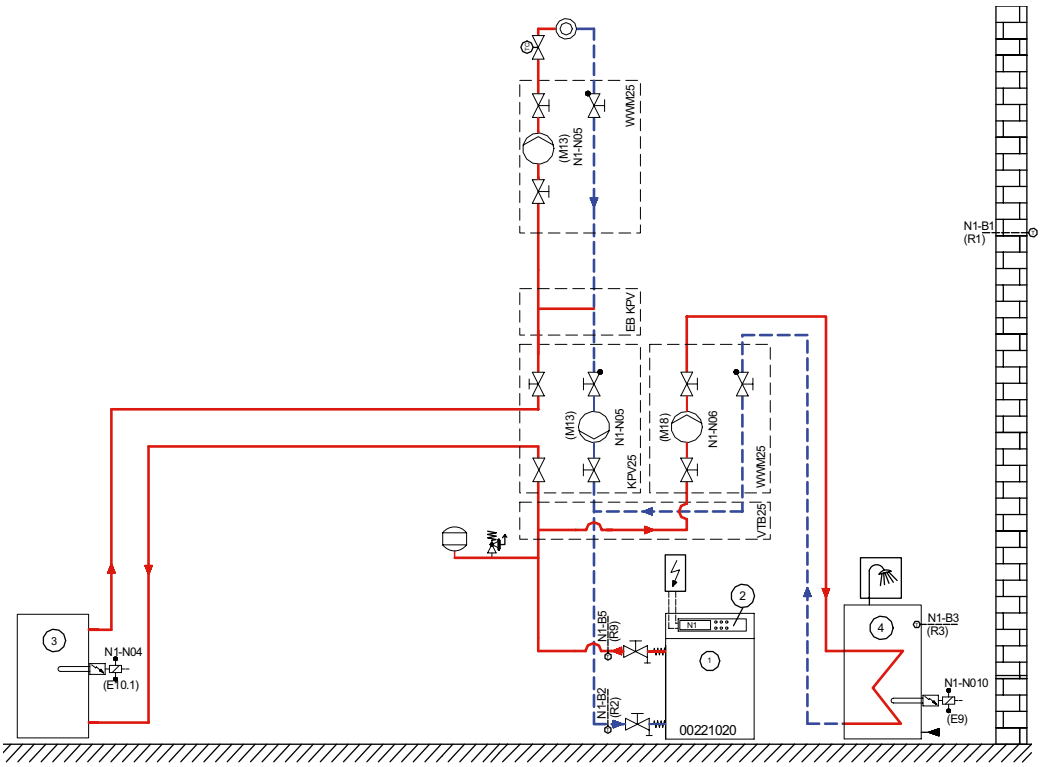


Fig. 8.27: Integration diagram for mono energy heat pump operation with one heating circuit, a buffer tank connected in series and hot water heating

Preconfiguration	Setting
Operating mode	Mono energy
1. Heating circuit 1	Yes
2. Heating circuit 1	No
Hot water preparation	Yes
Request	Sensors
Flange heater	Yes
Swimming pool preparation	No

The heating water flow must be ensured using a differential pressureless manifold (see *Chap. 8.3.4 on p. 176*)

The use of the KPV 25 compact manifold with EB KPV extension module is recommended for heat pumps with a heating water flow rate up to max. 2.0 mm^3/h.

Heating circuits with differential pressureless manifold

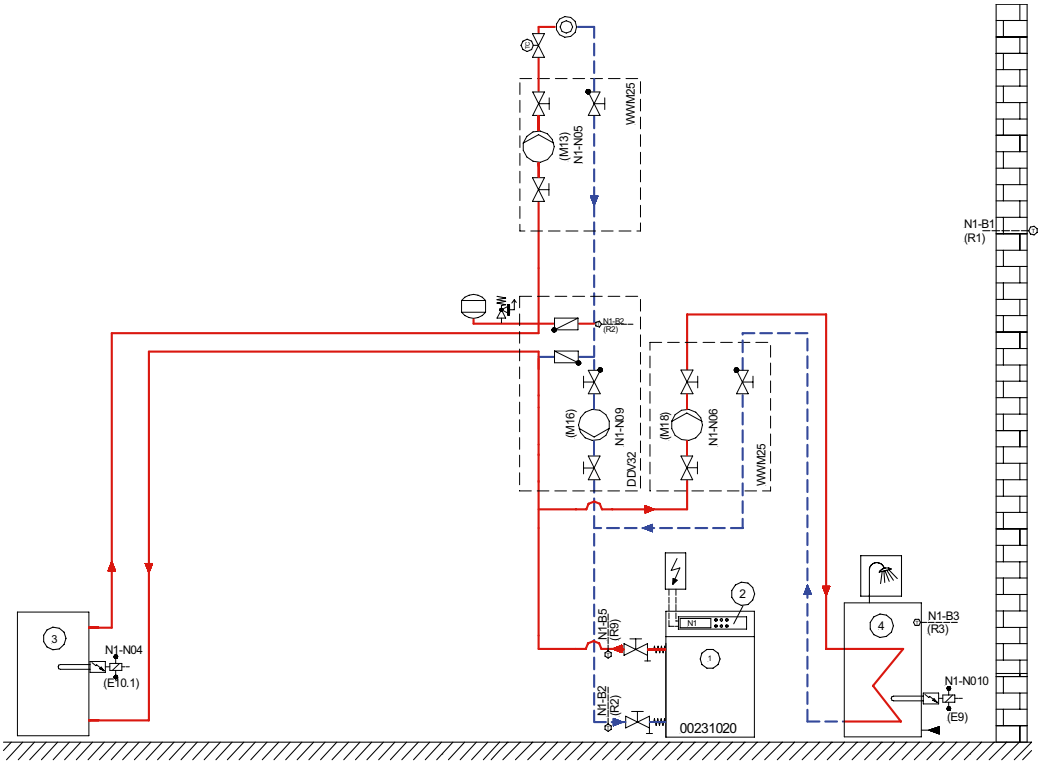


Fig. 8.28: Integration diagram for mono energy heat pump operation with one heating circuit, a buffer tank connected in series and hot water heating

Preconfiguration	Setting
Operating mode	Mono energy
1. Heating circuit 1	Yes
2. Heating circuit 1	No
Hot water preparation	Yes
Request	Sensors
Flange heater	Yes
Swimming pool preparation	No

The heating water flow must be ensured using a dual differential pressureless manifold (see *Chap. 8.4.3 on p. 178*)

The use of the DDV 32 compact manifold is recommended for heat pumps with a heating water flow rate up to max. 2.5 m^3/h.

Operation of the circulating pump (M16) in the generator circuit with the compressor in heating operation only, to avoid unnecessary operation

Three heating circuits with differential pressureless manifold

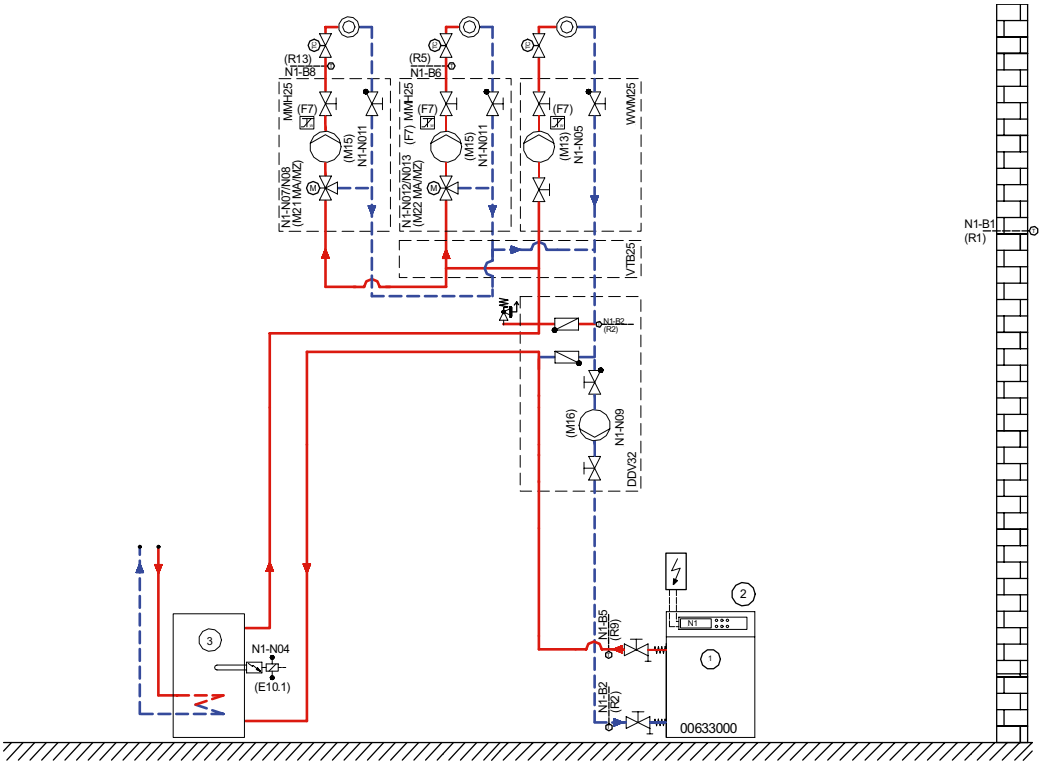


Fig. 8.29: Integration diagram for mono energy heat pump operation with three heating circuits, external supplementary heating and buffer tank connected in series

Preconfiguration	Setting
Operating mode	Mono energy
1. Heating circuit 1	Yes
2. Heating circuit 1	Yes
3. Heating circuit 1	Yes
Hot water preparation	No
Swimming pool preparation	No

A safety temperature monitor which protects the distribution system from impermissibly high temperatures must be used when the buffer tank connected in series is charged externally.

The dual differential pressureless manifold protects the heat pump since the circulating pump (M16) in the generator circuit is only active when the compressor is running in heating operation.

The heating circuit pumps M13/M15 supply the flow around the return flow sensor and prevent the heat pump from switching on when the system temperatures are too high.

Electrical connection of mono energy heat pump heating systems

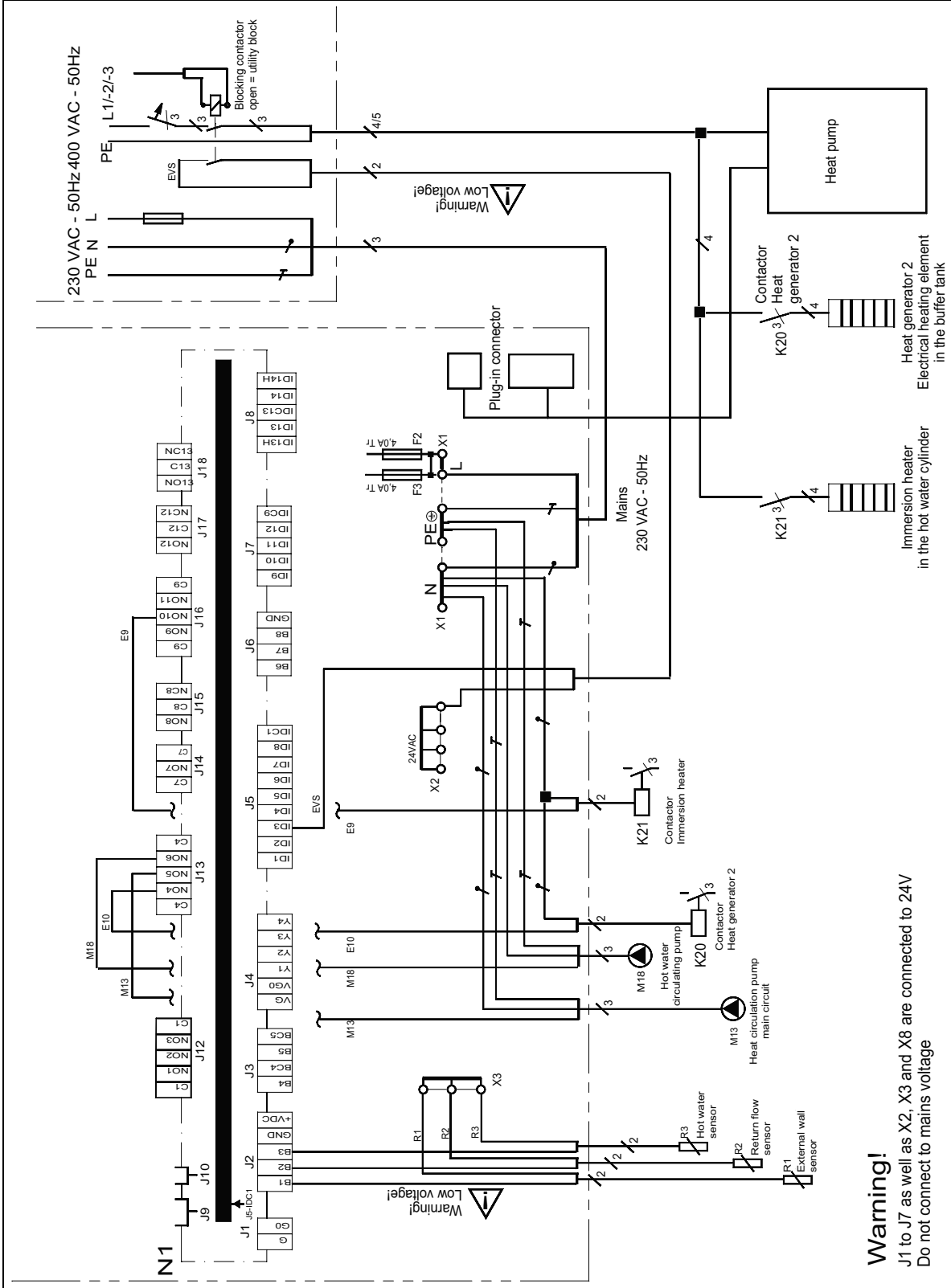


Fig. 8.30: Wiring diagram of a wall-mounted heat pump manager for a mono energy system with one heating circuit and domestic hot water preparation

The contactor (K20) for the immersion heater (E10) of mono energy systems (HG2) should be dimensioned according to the heat output and must be supplied by the customer. It is controlled (230 V AC) by the heat pump manager via the terminals X1/N and J13/NO 4.

The contactor (K21) for the flange heater (E9) in the hot water cylinder should be dimensioned according to the heat output and must be supplied by the customer. It is controlled (230 V AC) by the heat pump manager via the terminals X1/N and J16/NO 10.

8.12.5 Combination tanks and combo tanks

Central domestic hot water preparation via tube heat exchangers

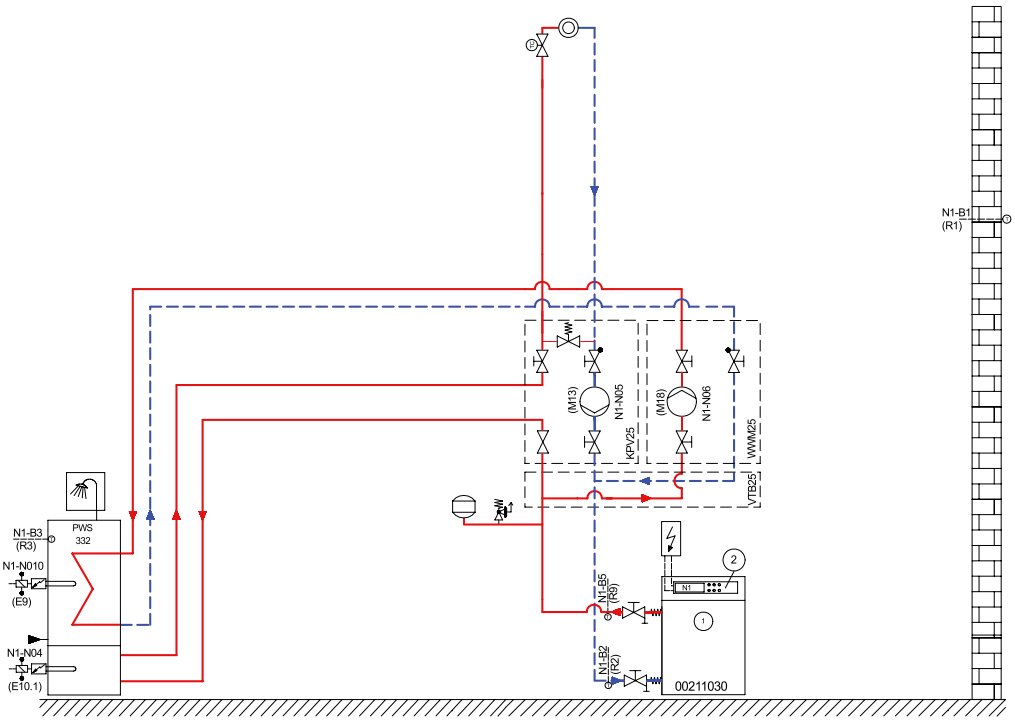


Fig. 8.31: Integration diagram for mono energy heat pump operation with one heating circuit and the PWS 332 combination tank

Preconfiguration	Setting
Operating mode	Mono energy
1. Heating circuit 1	Yes
2. Heating circuit 1	No
Hot water preparation	Yes
Request	Sensors
Flange heater	Yes
Swimming pool preparation	No

The combination tank consists of a 100 l buffer tank and a 300 l hot water cylinder which are hydraulically thermally independent of each other.

Domestic hot water is prepared using an integrated tube heat exchanger with 3.2 m^2 heat exchanger area.

Central domestic hot water preparation according to the flow principle

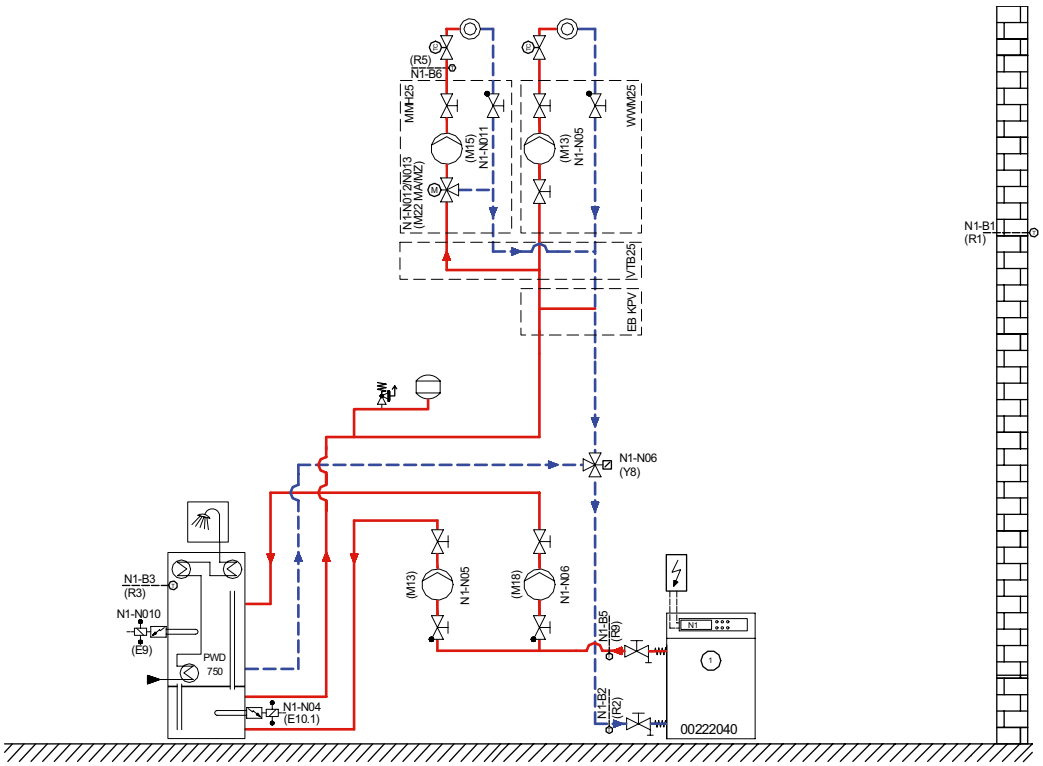


Fig. 8.32: Integration diagram for mono energy heat pump operation with two heating circuits and the PWD 750 combination tank

Preconfiguration	Setting
Operating mode	Mono energy
1. Heating circuit 1	Yes
2. Heating circuit 1	Yes
3. Heating circuit 1	No
Hot water preparation	Yes
Request	Sensors
Flange heater	Yes
Swimming pool preparation	No

The PWD 750 combination tank has a buffer tank volume of 750 l. 200 l of this are used as heating buffer and 550 l for domestic hot water preparation. The domestic hot water is prepared using integrated finned tube heat exchangers which heat up the domestic hot water according to the flow principle.

Integrated heat riser pipes use the heating buffer as preheating stage for hot water preparation.

A circular plate prevents the different water layers with varying temperatures from becoming mixed together.

8.12.6 Bivalent heat pump heating system

Boiler for supplementary heating

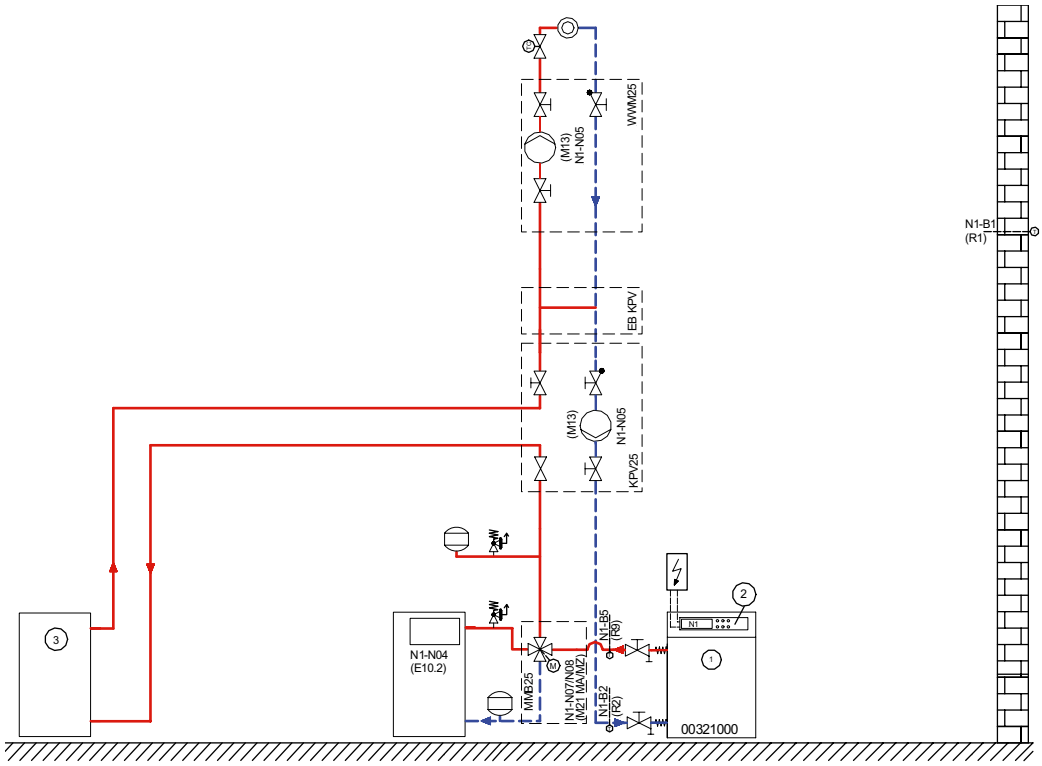


Fig. 8.33: Integration diagram for bivalent heat pump operation with a boiler, one heating circuit and a buffer tank connected in series

Preconfiguration	Setting
Operating mode	Bivalent Parallel
1. Heating circuit 1	Yes
2. Heating circuit 1	No
Hot water preparation	No
Swimming pool preparation	No

Regulation of the mixer is undertaken by the heat pump manager. If required, it calls for the boiler and adds more hot water until the desired set return temperature is reached.

The boiler is called via the heat generator 2 output of the heat pump manager and the mode of operation of heat generator 2 is coded as being “constant” (see *Chap. 8.9.1 on p. 184*).

Boiler for supplementing heating and DHW preparation

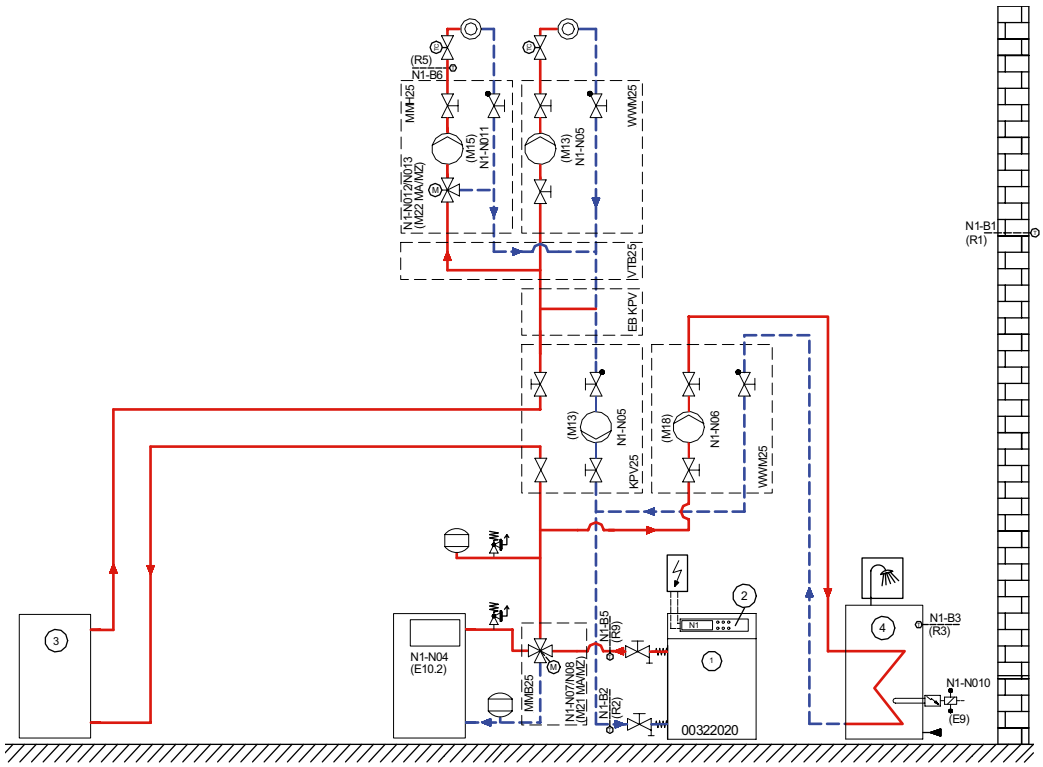


Fig. 8.34: Integration diagram for bivalent heat pump operation with a boiler, two heating circuits, a buffer tank connected in series and hot water heating

Preconfiguration	Setting
Operating mode	Bivalent Parallel
1. Heating circuit 1	Yes
2. Heating circuit 1	Yes
3. Heating circuit 1	No
Hot water preparation	Yes
Request	Sensors
Flange heater	Yes
Swimming pool preparation	No

The boiler can also be requested for DHW preparation to achieve higher hot water temperatures.

If an additional flange heater is installed in the hot water tank the boiler is only used for reheating and thermal disinfection when the flange heater is active in heating operation.

Electrical connection of bivalent heat pump heating systems

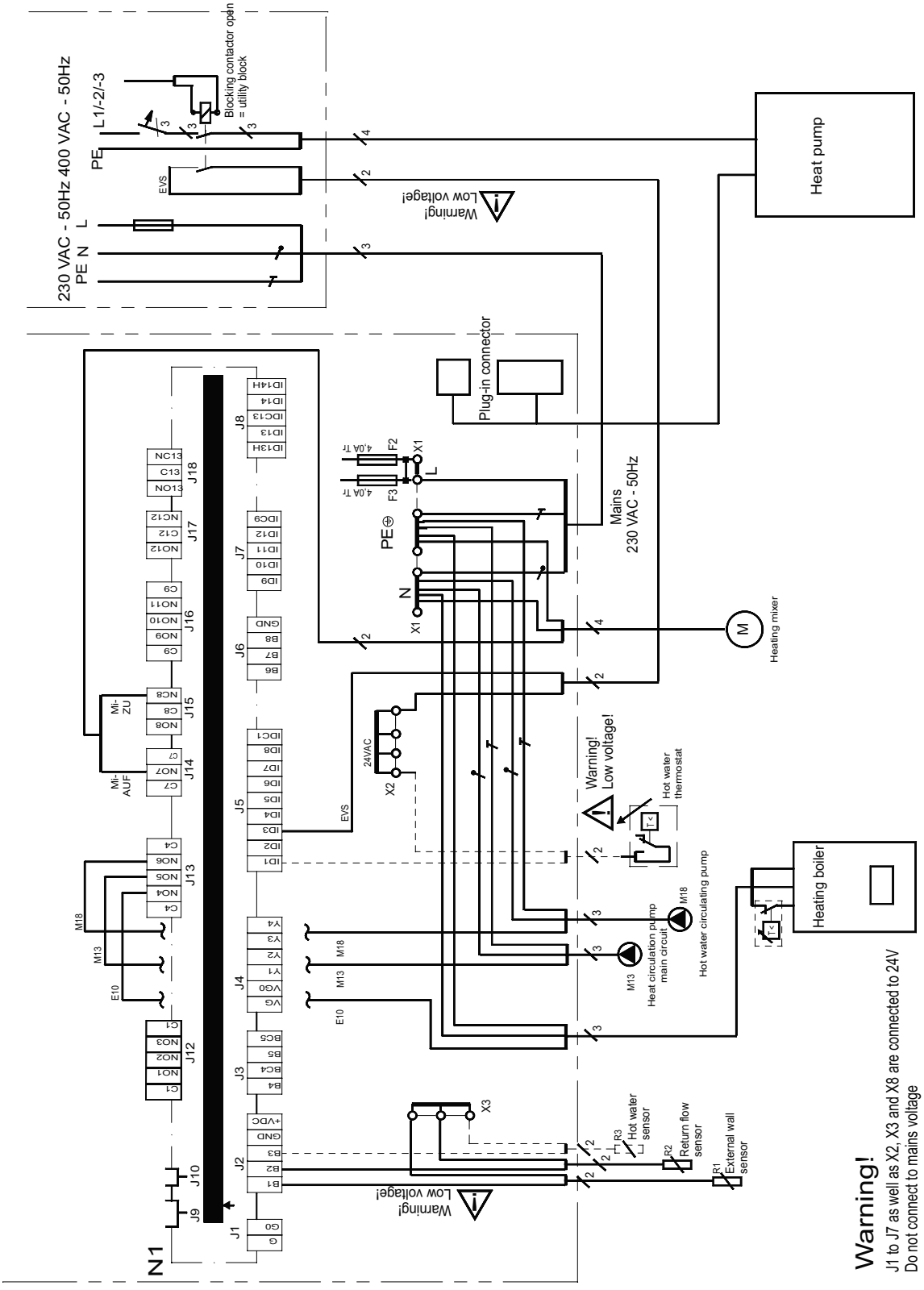


Fig. 8.35: Wiring diagram of a wall-mounted heat pump manager for a bivalent system with one heating circuit and a constantly-regulated or variably-regulated boiler

Constantly regulated boiler

Regulation of the mixer is undertaken by the heat pump manager. If required, it calls for the boiler and adds more hot water until the desired set return temperature or hot water temperature is reached. The boiler is called via the 2nd heat generator output of the heat pump manager and the mode of operation of the 2nd heat generator is coded as being “constant".

Variably-regulated boiler

Condensing boilers can also be operated via atmospherically controlled burner regulation. If required, the boiler is called via the 2nd heat generator output, the mixer is opened fully and the full volume flow is directed via the boiler. The mode of operation of the 2nd heat generator output is coded as being “variable”. The characteristic heating curve of the burner regulation is set in accordance with the characteristic heating curve of the heat pump.

8.12.7 Integration of renewable heat sources

Solar back-up for domestic hot water preparation

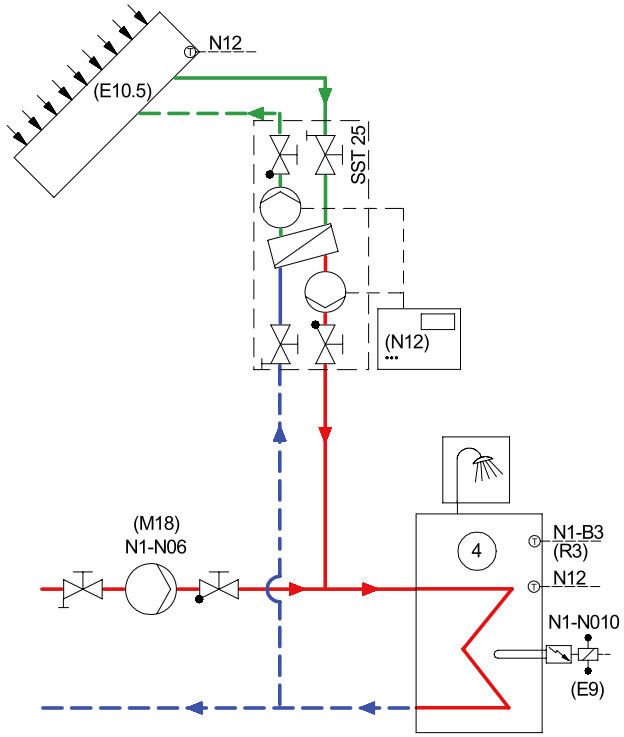


Fig. 8.36: Integration diagram (without safety valves) for a heat pump with solar back-up for domestic water preparation in combination with a solar station (special accessory SST 25).

The SST 25 solar station offers solar back-up for domestic hot water preparation.

The primary and the secondary cycle are separated via a plate heat exchanger which can be used for solar systems with a collector surface of up to 10 m^2.

Mode of operation:
The solar controller (N12) (must be supplied by customer) controls both circulating pumps installed in the solar station if there is a sufficiently large temperature difference ($T_{solar\ collector} > T_{dhw}$) between the solar collector $T_{solar\ collector}$ and the hot water cylinder T_{dhw}.
Hot water preparation with the heat pump should be blocked during the day using the adjustable time program on the heat pump manager.

External supplementary heating and solar back-up for DHW preparation

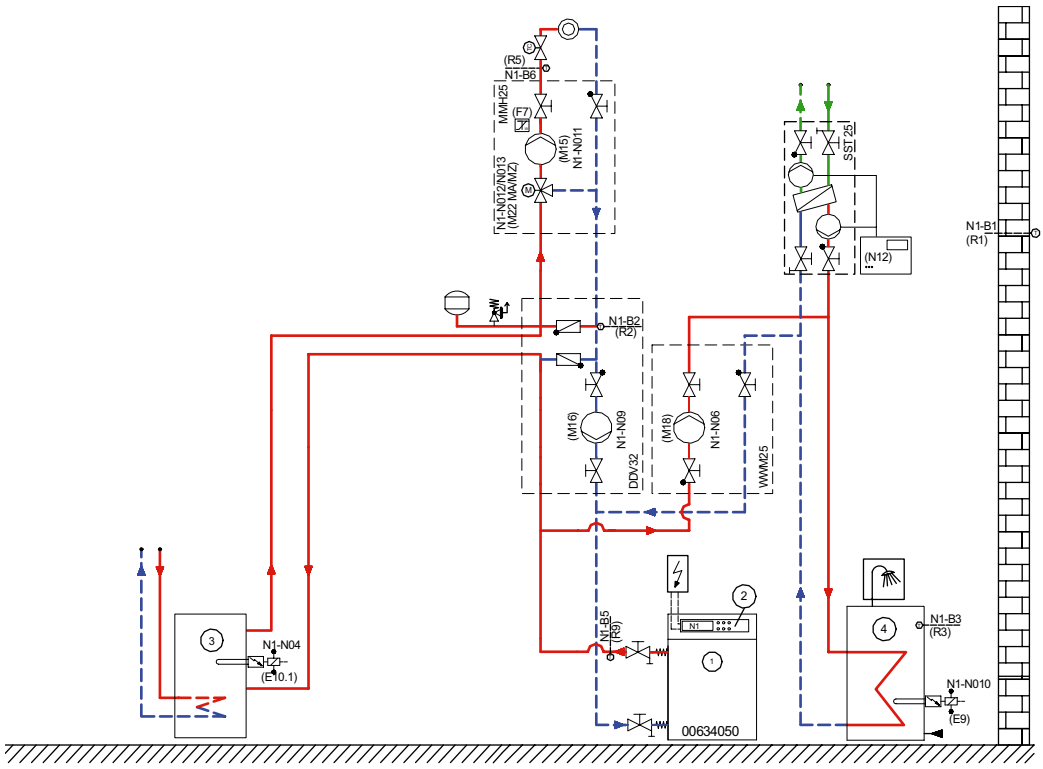


Fig. 8.37: Integration diagram for mono energy heat pump operation with one heating circuit, buffer tank connected in series with an external supplementary heating system and hot water preparation

Preconfiguration	Setting
Operating mode	Mono energy
1. Heating circuit 1	Yes
2. Heating circuit 1	Yes
3. Heating circuit 1	No
Hot water preparation	Yes
Request	Sensors
Flange heater	Yes
Swimming pool preparation	No

Supplementary heating
The return flow sensor must be fitted exactly in the position illustrated in the diagram to prevent the heat pump from switching on when the buffer tank is loaded.
The PSW 500 universal buffer tank has a flange connection for installation of a RWT 500 solar heat exchanger. A safety temperature monitor should be installed when panel heating systems are implemented (*Chap. 8.5.4 on p. 182*).

With permanent charging temperatures of over 50 °C the heat pump must be blocked via an additional thermostat for the domestic hot water and swimming pool water preparation (ID4).

Renewable back-up for heating and domestic hot water preparation

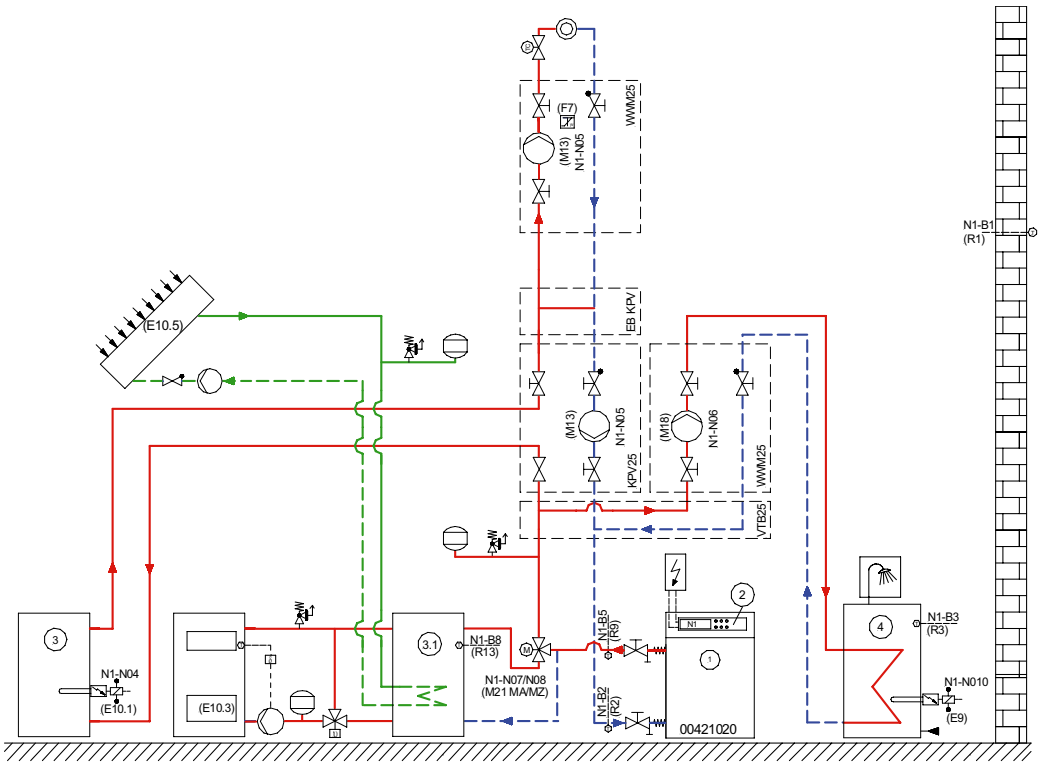


Fig. 8.38: Integration diagram for bivalent renewable heat pump operation of a solid fuel boiler with renewable cylinder, a heating circuit with buffer tank connected in series and domestic hot water preparation

Preconfiguration	Setting
Operating mode	Bivalent renewable
1. Heating circuit 1	Yes
2. Heating circuit 1	No
Hot water preparation	Yes
Request	Sensors
Flange heater	Yes
Swimming pool preparation	No

The renewable cylinder (3.1) is loaded by either the solid fuel boiler or by additional heat generators (e.g. solar). The buffer tank volume should be dimensioned according to data from the solid fuel boiler manufacturer.
With a sufficiently high temperature level in the renewable cylinder the heat pump is blocked and the energy from the cylinder is used for heating requests, hot water requirements and swimming pool needs.

Renewable back-up for heating and domestic hot water preparation

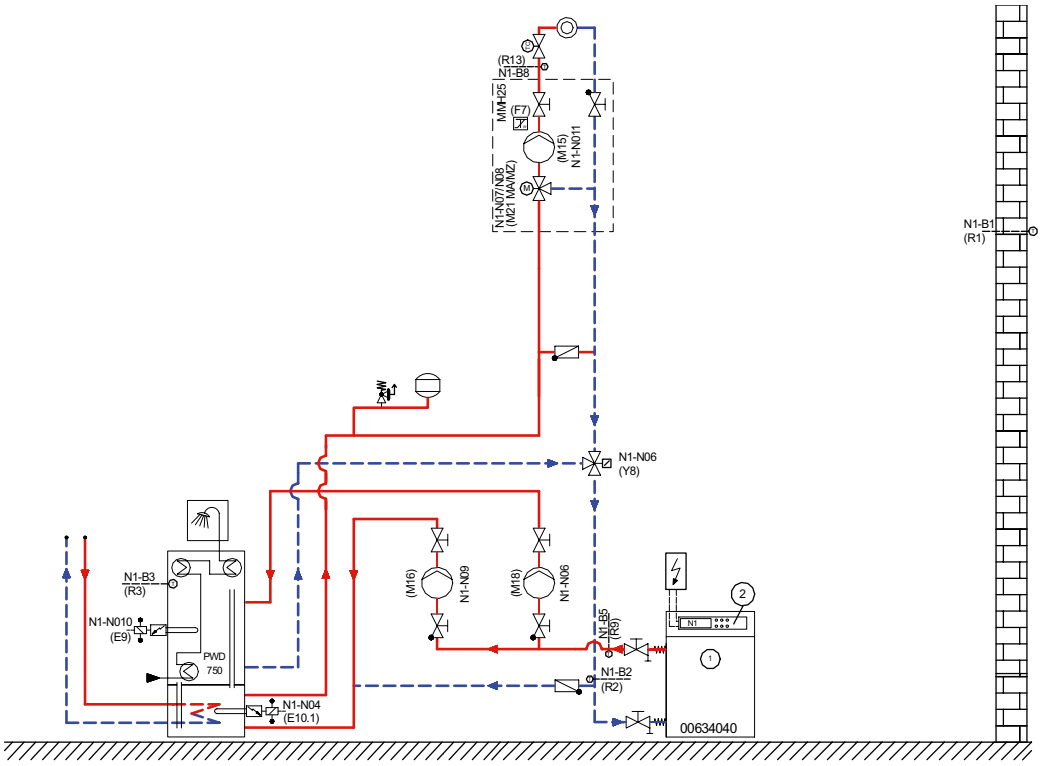


Fig. 8.39: Integration diagram for mono energy heat pump operation with PWD 750 combo tank for external back-up heating and domestic hot water preparation.

Preconfiguration	Setting
Operating mode	Mono energy
1. Heating circuit 1	Yes
2. Heating circuit 1	Yes
3. Heating circuit 1	No
Hot water preparation	Yes
Request	Sensors
Flange heater	Yes
Swimming pool preparation	No

A separating plate integrated into the combo tank in combination with a 3-way valve prevents mixing losses between the heating and the hot water zones.
With external charging heat riser pipes distribute the external energy to the supplementary heating system and the hot water preparation on the basis of the temperature.
A flange connection enables the installation of the RWT 750 solar heat exchanger.
The heating circuit pump M15 supplies the flow around the return flow sensor and prevents the heat pump from switching on when the system temperatures are too high.

Renewable back-up via a combo tank

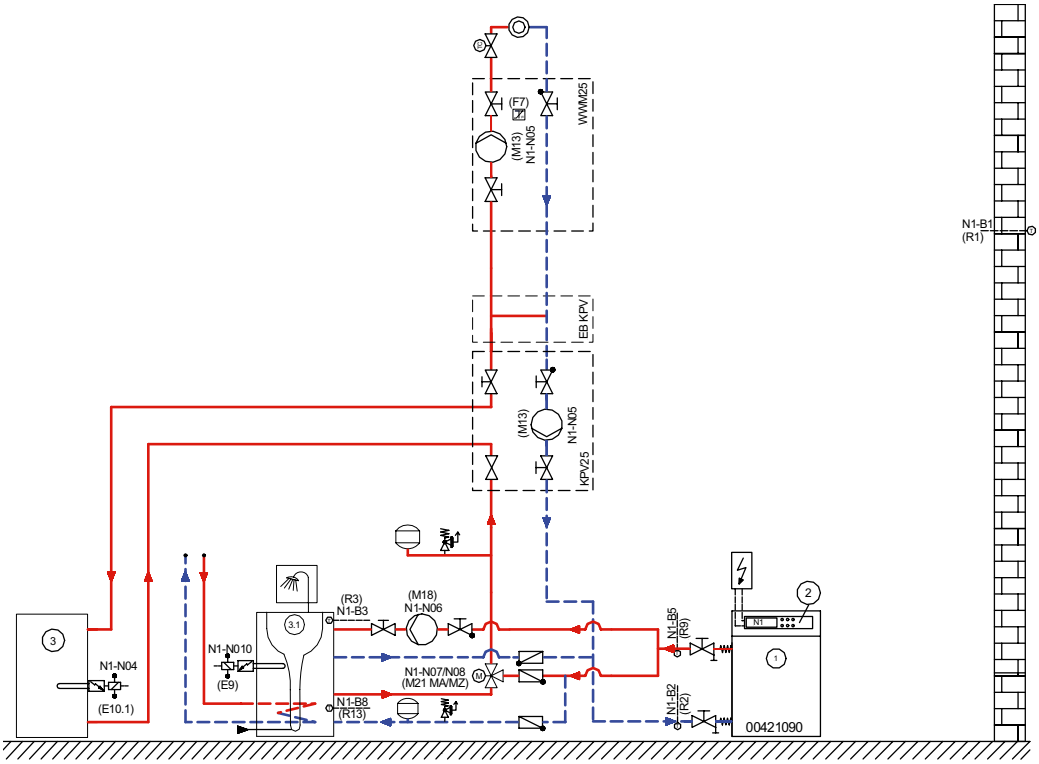


Fig. 8.40: Integration diagram for heat pump for bivalent renewable heat pump operation with external back-up domestic hot water preparation and heating using a combo tank without separating plate

Preconfiguration	Setting
Operating mode	Bivalent - renewable mode
1. Heating circuit 1	Yes
2. Heating circuit 1	Yes
Hot water preparation	Yes
Request	Sensors
Flange heater	No
Swimming pool preparation	No

Note:
The attainable hot water temperatures depend heavily on the design of the combo tank. With a combo tank without separating plate the additional buffer tank (3) ensures defrosting when air-to-water heat pumps are implemented. A sensor in the lower part of the combo tank blocks the heat pump and activates the mixer regulation. The water in the combo tank is heated by solar energy and is also used for supplementary heating (see also *Chap. 8.9.3 on p. 185*).

8.12.8 Swimming pool water preparation

Heating, domestic hot water and swimming pool water preparation

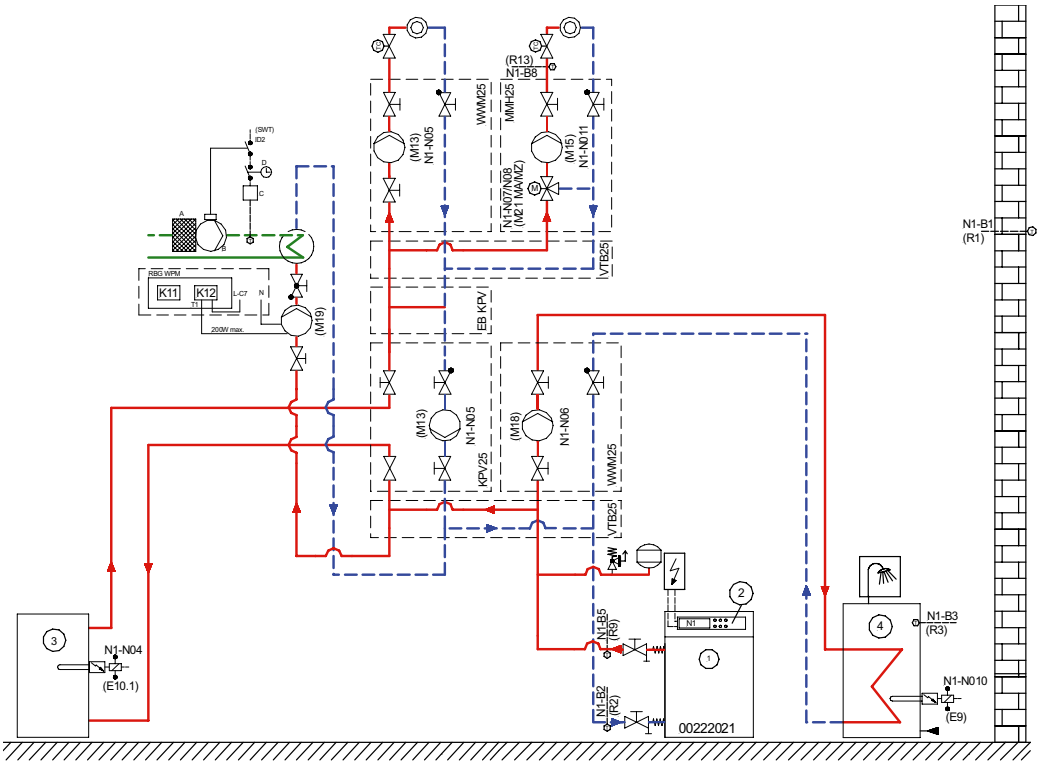


Fig. 8.41: Integration diagram for mono energy heat pump operation with two heating circuits, domestic hot water and swimming pool water preparation

Preconfiguration	Setting
Operating mode	Mono energy
1. Heating circuit 1	Yes
2. Heating circuit 1	Yes
3. Heating circuit 1	No
Hot water preparation	Yes
Request	Sensors
Flange heater	Yes
Swimming pool preparation	Yes

Order of priorities:
Hot water preparation has priority over heating and swimming pool preparation (see *Chap. 8.10 on p. 185*)

A relay module (special accessory) is required for the control of the M19 swimming pool circulating pump.

8.12.9 Parallel Connection of Heat Pumps

Dual differential pressureless manifold

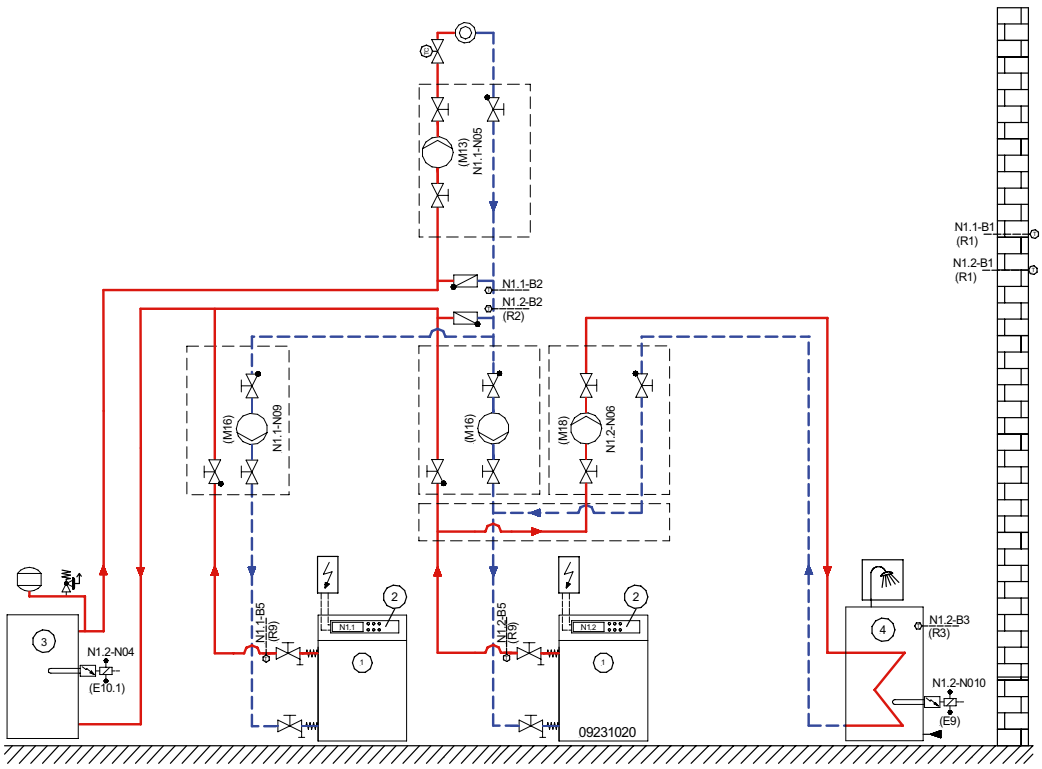


Fig. 8.42: Integration diagram for heat pumps connected in parallel, a buffer tank connected in series with two manifolds without differential pressure and hot water preparation

Preconfiguration	Setting	
Heat Pump	1.1	1.2
Operating mode	Monovalent	Mono energy
1. Heating circuit 1	Yes	Yes
2. Heating circuit 1	No	No
Domestic hot water preparation	No	Yes
Swimming pool preparation	No	No

Hot water preparation is carried out by the heat pump only.

With brine-to-water heat pumps each heat pump has its own brine circulating pump. A joint borehole heat exchanger or ground heat collector system can be used as heat source.

Parallel connection of heat pumps

A higher heat consumption can be met by connecting heat pumps in parallel. Different heat pump types can be used depending on the need. Large systems with more than three heat pumps switched in parallel are normally switched and disconnected using a higher-level load management system.

A parallel connection of heat pumps is also possible without a higher-level regulation through the existing heat pump manager:

- The same heating curves are set for all heat pump managers
- Using the “Hotter” and “Colder” arrow buttons, the second heat pump is set so that a difference in the return set temperature of 1K is achieved.
- The heat pump to which the domestic hot water preparation is connected, has the lowest setpoint and, if required, it controls a second heat generator.
- In systems with swimming pool water preparation the return flow sensor in the heating circuit must be switched to an additional sensor during swimming pool water preparation.

Regulation using higher-level load management systems

The higher-level regulation must have a floating switch output per heat pump compressor. The following solution is recommended for a parallel connection:

1) The heat pump managers of both heat pumps are set to fixed-setpoint regulation with maximum required return set temperature. This leads to the automatic connection of the second compressor in case of high heating needs.
2) The outputs ID1 and ID4 are used for the heating requirements using one or both compressors

Power stage	Contact position
0 = heat pump off	ID4 open
1 = heat pump on with 1 compressor	ID4 closed ID1 closed
2 = heat pump on with 2 compressors	ID4 closed ID1 open

The second compressor is not connected before expiry of the switch cycle block (20 minutes).

“DHW preparation with thermostat” must be chosen during preconfiguration. The hot water settings must be such that the domestic hot water preparation is always done using a compressor (switching to 2nd compressor: -25°C).

The regulation of an existing domestic hot water preparation incl. pump control must be matched to the external regulation.

9 Investment and Operating Costs

The overall costs of a heating system consist of three parts:

- Investments
- Energy costs
- Incidental costs

Investments have to be made at the start of construction work for installation of the heating system. This should be broken down into annual instalments for a profitability analysis. Energy costs and incidental costs normally accrue annually. To be able to compare the different types of heating systems, these three types of costs must be added together accordingly. A comparison is normally made of the annual costs or “heat production costs”. The heat production costs represent the costs of one heat unit (e.g. kWH).

$k_{heat} = k_{investment} + k_{energy\ costs} + k_{incidental\ costs}$

A simplified costing can be made by dividing the investments by the number of operating years to calculate the annual instalments. To carry out a full costing (including interest), the investments are broken down into annual instalments on the basis of the interest rate and the operating period. The most frequently used calculation method is the annuity method which assumes the heat demand to remain constant. The annual investment instalments are calculated using this method as follows:

$$k_{Investment} = K_{Investment} \cdot \frac{z \cdot (1+z)^n}{(1+z)^n - 1}$$

whereby:

$k_{Investment}$	Annual proportion of investment costs
$K_{Investment}$	Investment at start of construction work
z	Interest rate
n	Operating period

Comparison of costs		Oil heating	Heat Pump
Investment ÷ operating period	**€/a**		
Incidental costs (*Chap. 9.1 on p. 201*)	**€/a**		
Energy costs	**€/a**		
Total costs			

9.1 Incidental Costs

Frequently, only the investment costs and the energy costs are used for a cost comparison of heating systems. However, other factors such as the power supply connection or maintenance contracts can also considerably increase the annual incidental costs depending on the type of heating system implemented.

	Oil heating		Heat Pump	
Incidental costs	**Values based on past experience**	**Your figures**	**Values based on past experience**	**Your figures**
Transfer price of heat pump meter			55.00-- €	
Power for circulating pump / burner	130.00-- €		30.00-- €	
Chimney sweep incl. emissions measurement	55.00-- €			
Maintenance contract	125.00-- €			
Repairs 1.25 % of purchasing costs	50.00-- €		65.00-- €	
Insurance for internal oil tank	80.00-- €			
Interest on tank reserve	50.00-- €			
Tank cleaning (necessary provision)	40.00-- €			
Total incidental costs	**530.00-- €**		**150.00-- €**	

Heat pump systems can be compiled on the following pages in order to calculate the required investment costs.

Different types of heat pump systems for monovalent, mono energy and bivalent operation can be compared with a oil heating system to calculate the energy costs (in *Chap. 9.2 on p. 202*).

The annual energy costs of a gas heating system can be compared in a similar manner, although the costs for this type of system are normally higher than for oil heating systems.

NOTE

Visit www.dimplex.de to use our operating cost calculator to compare different types of heat generators.

9.2 Energy Costs

9.2.1 Oil heating - monovalent heat pump heating system

Heat requirement

Heat requirement Q_a in kW = [ ] m²* Residential floor space × [ ] kW/m² Specific heat requirement = [ ] kW

Specific heat requirement of Qh = 0,05 kW/m² (good insulation)
= 0,10 kW/m² (poor insulation)

Annual energy requirement

Annual energy requirement Q_a in kWh/a = [ ] kW* Heat requirement × [ ] h/a Annual full utilisation hours = [ ] kwh/a

e.g. 2000 h/a

Oil requirement

Oil requirement in l/a = [ ] kWh/a Annual energy requirement: Qa / (10,08 * Lower heating value × [ ] Annual utilisation level) = [ ] l/a

Lower heating value of oil = 10,08 kWh/l
Annuel utilisation level e.g. = 0,75

Monovalent operating mode

Energy requirement HP in kWh/a = [ ] kWh/a Annual energy requirement Qa / [ ] Annual energy factor β = [ ] kWh/a

Cost calculation

Oil costs = [ ] l/a * Oil requirement × [ ] €/l Oil price = [ ] €/a

Power costs heat pump = [ ] kWh*/a Energy requirement heat pump × [ ] €/kWh Power price = [ ] €/a

Savings = [ ] €/a Oil costs × [ ] €/a Power costs HP = [ ] €/a

Heat consumption:

The heat consumption is normally calculated by the heating system engineer (e.g. architect)

Annual performance factor:

This is dependent on the type of heat pump and the way it is integrated in the heating system. An approximate calculation of the annual performance factor can be made using the method shown in *Chap. 9.3 on p. 205*.

NOTE

Visit www.dimplex.de to use our annual performance factor calculator for Dimplex heat pumps.

9.2.2 Oil heating - mono energy heat pump heating systems

Heat requirement

Heat requirement Q_a in kW = [ ] m^2 * [ ] $\frac{kW}{m^2}$ = [ ] kW

Residential floor space | Specific heat requirement

Specific heat requirement of Qh = 0,05 kW/m² (good insulation)
= 0,10 kW/m² (poor insulation)

Annual energy requirement

Annual energy requirement Qa in kWh/a = [ ] kW * [ ] $\frac{h}{a}$ = [ ] $\frac{kWh}{a}$

Heat requirement | Annual full utilisation hours e.g. 2000 h/a

Oil requirement

Oil requirement in l/a = $\frac{\text{[ ] } \frac{kWh}{a}}{\text{[ ] Lower heating value} * \text{[ ] Annual utilisation level}}$ = [ ] $\frac{l}{a}$

Annual energy requirement Qa | Lower heating value of oil = 10,08 kWh/l | Annual utilisation level e.g. = 0,75

Mono-energy operating mode

Energy requirement HP in kwh/a = $\frac{\text{[ ] } \frac{kWh}{a}}{\text{[ ] Annual energy factor } \beta} * \text{[ ] Annual heating performance Share of HP e.g. 97\%}$ = [ ] $\frac{kWh}{a}$

Annual energy requirement Qa

Additional electrical heating = [ ] $\frac{kWh}{a}$ * [ ] = [ ] $\frac{kWh}{a}$

Annual energy requirement | 1 -fm (e.g. 1-0,97% = 3%) (Part of additional electrical heating)

Cost calculation

Oil costs = [ ] $\frac{l}{a}$ * [ ] $\frac{€}{l}$ = [ ] $\frac{€}{a}$

Oil requirement | Oil price

Power costs heat pump [ ] $\frac{kWh}{a}$ + [ ] $\frac{kWh}{a}$ * [ ] $\frac{€}{kWh}$ = [ ] $\frac{€}{a}$

Energy requirement heat pump | Energy requirement additional heating | Power price

Savings = [ ] $\frac{€}{a}$ - [ ] $\frac{€}{a}$ = [ ] $\frac{€}{a}$

Oil costs | Power costs HP

Heat consumption:

The heat consumption is normally calculated by the heating system engineer (e.g. architect)

Annual performance factor:

This is dependent on the type of heat pump and the way it is integrated in the heating system. An approximate calculation of the annual performance factor can be made using the method shown in *Chap. 9.3 on p. 205*.

Annual heat output:

The percentage covered by the heat pump (see *Chap. 1 on p. 10*) is primarily dependent on the selected bivalence point (e.g. -5 ° C).

NOTE

Visit www.dimplex.de to use our annual performance factor calculator for Dimplex heat pumps.

9.2.3 Oil heating - parallel bivalent heat pump heating system

Heat requirement

Heat requirement Qa in kW = ____ m²* (Residential floor space) ____ kW/m² (Specific heat requirement) = ____ kW

Specific heat requirement of Qh = 0,05 kW/m² (good insulation)
= 0,10 kW/m² (poor insulation)

Annual energy requirement

Annual energy requirement Qa in kWh/a = ____ kW* (Heat requirement) x ____ h/a (Annual full utilisation hours, e.g. 2000 h/a) = ____ kwh/a

Oil requirement

Oil requirement in l/a = ____ kWh/a (Annual energy requirement Qa) / ____ * (Lower heating value, Oil: 10,08 kWh/l) ____ (Annual utilisation level, e.g. = 0,75) = ____ l/a

Bivalent operating mode

Energy requirement HP in kWh/a = ____ kWh/a (Annual energy requirement Qa) / ____ (Annual energy factor β) x ____ (Annual heating performance, Share of HP, e.g. 97%) = ____ kWh/a

Oil consumption additional heating = - (Annual energy requirement Qa) / ____ kWh/a (Lower heating value Hu) x ____ (Annual utilisation level) x ____ (1 - fm) (Part of heating with oil (e.g. 10%)) = ____ l/a

Cost calculation

Oil costs = ____ l/a (Oil requirement) x ____ €/l (Oil price) = ____ €/a

Oil costs additional heating bivalent mode = ____ kWh/a (Oil cinsumption additional heating Energy requirement) x ____ €/l (Oil price) = ____ €/a

Energy costs system bivalent mode = ____ kWh/a (Pompe à chaleur Energy requirement) x ____ €/kWh (Power price) + ____ €/a (Oil costs for additional heating) = ____ €/a

Savings = ____ kWh/a (Oil costs) - ____ €/kWh (Energy costs system) = ____ €/a

Annual heat output:

The percentage covered by the heat pump (see chapter Selection and Design of Heat Pumps) is primarily dependent on the selected bivalence point (e.g. – 5 °C) .

Annual performance factor:

This is dependent on the type of heat pump and the way it is integrated in the heating system. An approximate calculation of the annual performance factor can be made using the method shown in *Chap. 9.3 on p. 205*.

9.3 Calculation Sheet for Approximate Determination of the Annual Performance Factor of a Heat Pump System

The annual performance factor β of the installed heat pump system is calculated using the simplified short calculation method based on the correction factors $F_{operation}$ (F_{υ}) and $F_{liquefier}$ ($F_{\Delta\upsilon}$) according to VDI 4650, as well as using the coefficient(s) of performance (COP) $\varepsilon_{standard}$ according to EN 255 as follows:

1. Step: Select the appropriate calculation equation
⇒ i) Determine the type of heat pump

i) ☐ Brine-to-water heat pump ☐ Water-to-water heat pump

$$\beta_{Brine\text{-}HP} = \varepsilon_{Standard1} \cdot F_{Condenser} \cdot \frac{F_{Operation1}}{1{,}075} \qquad \beta_{Water\text{-}HP} = \varepsilon_{Standard1} \cdot F_{Condenser} \cdot \frac{F_{Operation1}}{1{,}14}$$

☐ Air-to-water heat pumps

$$\beta_{Air\text{-}HP} = \left(\varepsilon_{Standard1} \cdot F_{Operation1} + \varepsilon_{Standard2} \cdot F_{Operation2} + \varepsilon_{Standard3} \cdot F_{Operation3}\right) \cdot F_{Condenser}$$

2. Step: Determine the relevant COP(s) $\varepsilon_{standard}$ of the heat pump
⇒ i) Determine the design-specific standard operating point(s)
⇒ ii) Use COP(s) measured according to the EN 255 $\varepsilon_{standard}$

i) ☐ Brine-to-water (B0/W35) ☐ Water-to-water (W10/W35) ☐ Air-to-water (A-7;2;10/W35)

ii) COP $\varepsilon_{standard\ 1}$: _____ (at B0/W35 or W10/W35 or A-7/W35)
COP $\varepsilon_{standard\ 2}$: _____ (only air-to-water heat pumps at A2/W35)
COP $\varepsilon_{standard\ 3}$: _____ (only air-to-water heat pumps at A10/W35)

3. Step: Determine the correction factor for the deviating temperature difference at the liquefier
⇒ i) Determine the temperature difference $\Delta\vartheta_M$ which was set during the test stand measurement
⇒ ii) Determine the actual temperature difference $\Delta\vartheta_B$ under operating conditions
⇒ iii) Determine the correction factor $F_{\Delta\upsilon}$ using *Table 9.1 on p. 205*

i) _____K temperature difference $\Delta\vartheta_B$ at the liquefier under test stand conditions at
☐ Brine-to-water (B0/W35) ☐ Water-to-water (W10/W35) ☐ Air-to-water (A2/W35)

ii) _____K temperature difference $\Delta\vartheta_B$ at the liquefier under operating conditions at (see i).

iii) Correction factor $F_{liquefier}$ (see *Table 9.1 on p. 205*): _____
(Intersection point of $\Delta\vartheta_M$ vertical and $\Delta\vartheta_B$ horizontal)

		Temperature difference during the test stand measurement $\Delta\upsilon$ [K]												
		3	4	5	6	7	8	9	10	11	12	13	14	15
Temp. difference during operation [K]	$\Delta\upsilon$=3	1.000	0.990	0.980	0.969	0.959	0.949	0.939	0.928	0,918	0.908	0.898	0.887	0.877
	$\Delta\upsilon$=4	1.010	1.000	0.990	0.980	0.969	0.959	0.949	0.939	0.928	0.918	0.908	0.898	0.887
	$\Delta\upsilon$=5	1.020	1.010	1.000	0.990	0,980	0.969	0.959	0.949	0.939	0.928	0.918	0.908	0.898
	$\Delta\upsilon$=6	1.031	1.020	1.010	1.000	0.990	0.980	0.969	0.959	0.949	0.939	0.928	0.918	0.908
	$\Delta\upsilon$=7	1.041	1.031	1.020	1.010	1.000	0.990	0.980	0.969	0.959	0.949	0.939	0.928	0.918
	$\Delta\upsilon$=8	1.051	1.041	1.031	1.020	1.010	1.000	0.990	0.980	0.969	0.959	0.949	0.939	0.928
	$\Delta\upsilon$=9	1.061	1.051	1.041	1.031	1.020	1.010	1.000	0.990	0.980	0.969	0.959	0.949	0.939
	$\Delta\upsilon$=10	1.072	1.061	1.051	1.041	1.031	1.020	1.010	1.000	0.990	0.980	0.969	0.959	0.949

Table 9.1: Correction factor $F_{\Delta\upsilon}$ for deviating temperature differences at the liquefier

4. Step: Determine the correction factor for the existing operating conditions
⇒ i) Determine the maximum flow temperature as specified on the day the system design was established according to DIN 4701
⇒ ii) Determine the mean heat source temperature and location
⇒ iii) Determine correction factor(s) F_{υ} using Tables 2a-c)

i) Maximum flow temperature as specified on the day the system design was established _____°C

ii) ☐ Brine-to-water — Mean brine temperature: _____°C

☐ Water-to-water — Mean ground water temperature: _____°C

☐ Air-to-water — Location of the heat pump in compliance with DIN 4701: ☐ **E**ssen ☐ **M**unich ☐ **H**amburg ☐ **B**erlin ☐ **F**rankfurt

iii) ☐ Air-to-water (see *Table 9.2 on p. 206*)

Correction factor Fυ: _____ (at A-7/W35)

Correction factor Fυ: _____ (at A2/W35)

Correction factor Fυ: _____ (at A10/W35)

(Intersection points of the max. flow temperature and the three external temperatures -7, 2 and 10 °C at the selected location)

☐ Brine-to-water (see *Table 9.3 on p. 206*) ☐ Water-to-water (see *Table 9.4 on p. 206*)

Correction factor $F_{\text{operation 1}}$: _____

(Intersection point of max. flow temperature (30-55 °C) and heat source temperature (TBrine, TWater)

$T_{\text{max. flow}}$ [°C]		30	35	40	45	50	55
Essen	-7 °C	0.070	0.066	0.062	0.059	0.055	0.051
	2 °C	0.799	0.766	0.734	0.701	0.668	0.635
	10 °C	0.258	0.250	0.242	0.233	0.225	0.217
Munich	-7 °C	0.235	0.224	0.213	0.202	0.191	0.180
	2 °C	0.695	0.668	0.642	0.616	0.590	0.564
	10 °C	0.173	0.168	0.163	0.158	0.153	0.147
Hamburg	-7 °C	0.109	0.104	0.098	0.092	0.087	0.081
	2 °C	0.794	0.762	0.730	0.698	0.667	0.635
	10 °C	0.212	0.205	0.198	0.192	0.185	0.179
Berlin	-7 °C	0.144	0.137	0.130	0.123	0.116	0.109
	2 °C	0.776	0.767	0.716	0.686	0.656	0.626
	10 °C	0.188	0.182	0.177	0.171	0.165	0.160
Frankfurt	-7 °C	0.088	0.084	0.079	0.075	0.070	0.066
	2 °C	0.799	0.767	0.735	0.704	0.672	0.640
	10 °C	0.234	0.227	0.220	0.212	0.205	0.198

Table 9.2: Correction factors $F_{\text{operation}}$ for different operating conditions for air-to-water heat pumps

$T_{\text{max. flow}}$ [°C]		30	35	40	45	50	55
T_{Brine} [°C]	2	1.161	1.113	1.065	1.016	0.967	0.917
	1	1.148	1.100	1.052	1.003	0.954	0.904
	0	1.135	1.087	1.039	0.990	0.940	0.890
	-1	1.122	1.074	1.026	0.977	0.927	0.877
	-2	1.110	1.062	1.014	0.965	0.915	0.864
	-3	1.099	1.051	1.002	0.953	0.903	0.852

Table 9.3: Correction factors Fu for different operating conditions for brine-to-water heat pumps

$T_{\text{max. flow}}$ [°C]		30	35	40	45	50	55
T_{Water} [°C]	12	1.158	1.106	1.054	1.000	0.947	0.892
	11	1.139	1.087	1.035	0.981	0.927	0.873
	10	1.120	1.068	1.016	0.962	0.908	0.853
	9	1,101	1,049	0,997	0,943	0,889	0,834
	8	1.082	1.030	0.978	0.924	0.870	0.815

Table 9.4: Correction factors Fu for different operating conditions for water-to-water heat pumps

5. Step: Use the correction factor(s) F_{υ}, $F_{\Delta\upsilon}$ and COP(s) $\varepsilon_{\text{standard}}$ according to step 1) and calculate the annual performance factor β

☐ Brine-to-water and water-to-water heat pumps

$$\beta = \quad \cdot \quad \cdot \frac{\qquad}{\qquad} = \underline{\qquad}$$

☐ Air-to-water heat pumps

$$\beta = \left(\quad \cdot \quad + \quad \cdot \quad + \quad \cdot \quad \right) \cdot \quad = \underline{\qquad}$$

NOTE

Both the location of the system and the auxiliary power supply should be taken into consideration when calculating the annual performance factor according to VDI 4650. In contrast, the annual performance factor is calculated according to EnEV, DIN V 4701-T10 (1 / generator effort figure) and is independent of the location of the system. The auxiliary power consumption is examined separately.

NOTE

Visit www.dimplex.de to use our annual performance factor calculator for Dimplex heat pumps.

10 Help with Planning and Installation

10.1 Template for Experimental Determination of the Actually Required System Temperature

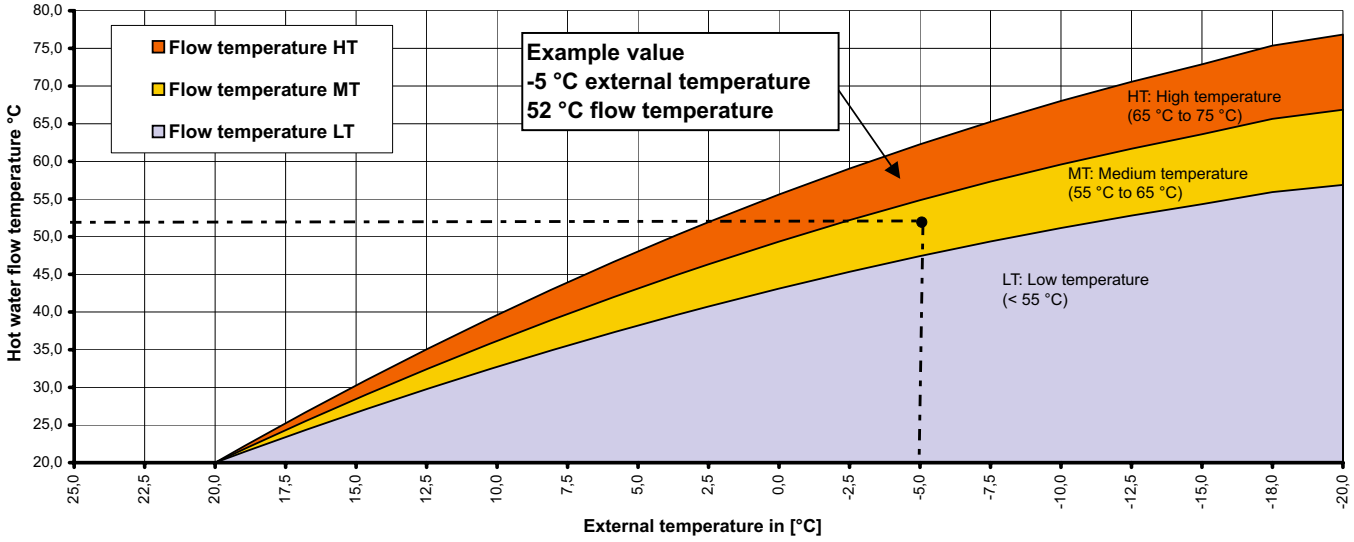


Fig. 10.1: Diagram for experimental determination of the actually required system temperature

Measured values	Example	1	2	3	4	5	6	7	8	9
External temperature	-5 °C									
Flow temperature	52 °C									
Return temperature	42 °C									
Temp. difference	10 °C									

Carry out the following steps during the heating period at different external temperatures:

1. Step: Set the thermostats in rooms with high heat consumption (e.g. bathroom and living room) to the highest level (valve fully open!).

2. Step: Reduce the flow temperature at the boiler or at the mixer valve until the desired room temperature of approx. 20-22 °C is reached (note: take the sluggishness of the heating system into consideration!)

3. Step: Enter the flow and return temperatures and the external temperature in the table.

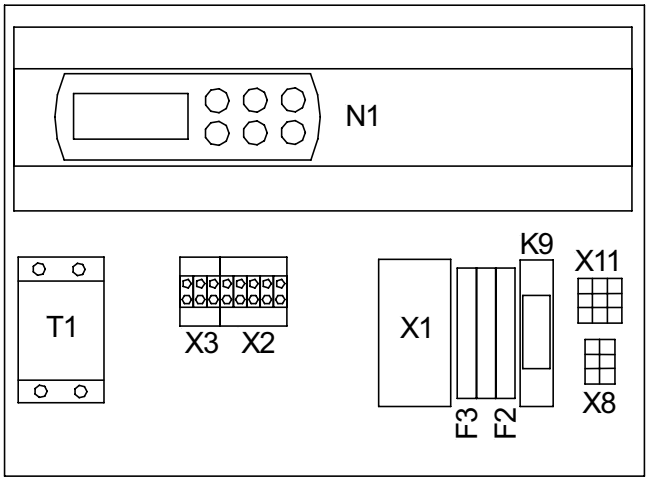
4. Step: Transfer the measured values to the diagram.

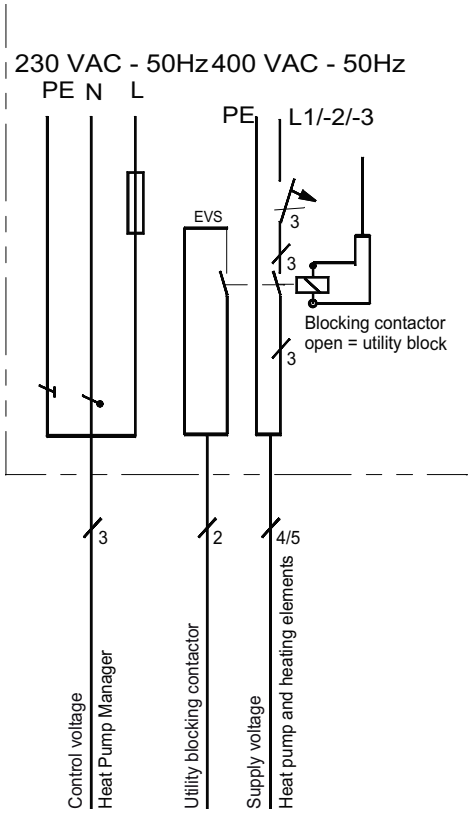
10.2 Electrical Installations for the Heat Pump

1) The four-core **supply cable** for the **output section of the heat pump** is fed from the heat pump meter via the utility company's contactor (if required) into the heat pump (3L/PE~400 V, 50 Hz).
   The system must be protected according to the power consumption data on the type plate using a 3-pole miniature circuit breaker with C characteristic and common tripping for all 3 paths.
   Cable cross section in compliance with DIN VDE 0100
2) The three-core **supply cable** for the **heat pump manager** (N1 heat pump controller) is fed into the heat pump (device with integrated controller) or to the future mounting location of the wall-mounted heat pump manager (HPM).
   The (L/N/PE~230 V, 50 Hz) supply cable for the heat pump manager must have a constant voltage. For this reason, it should be tapped upstream from the utility blocking contactor or be connected to the household current, because otherwise important protection functions could be lost during a utility block.
3) The **utility blocking contactor**(K22) with 3 main contacts (1/3/5 // 2/4/6) and an auxiliary contact (NO contact 13/14) should be dimensioned according to the heat pump output and must be supplied by the customer.
   The NO contact of the utility blocking contactor (13/14) is looped from terminal strip X2 to the connector terminal J5/ID3. **CAUTION! Extra-low voltage!**
4) The **contactor** (K20) for the **immersion heater** (E10) of mono energy systems (HG2) should be dimensioned according to the radiator output and **must be supplied by the customer**. It is controlled (230 V AC) by the heat pump manager via the terminals X1/N and J13/NO 4.
5) The **contactor** (K21) for the **flange heater** (E9) in the hot water cylinder should be dimensioned according to the radiator output and **must be supplied by the customer**. It is controlled (230 V AC) by the heat pump manager via the terminals X1/N and J16/NO 10.
6) The contactors mentioned above in points 3, 4 and 5 are installed in the distribution cabinet. The five-core mains cables (3L/N/PE 400 V ~50 Hz) for the radiators should be rated and protected according to DIN VDE 0100.
7) The **heat circulating pump** (M13) is connected to the terminals X1/N and **J13/NO 5**.
8) The **hot water circulating pump** (M18) is connected to the terminals X1/N and **J13/NO 6**.
9) The brine or well pump is connected to the X1/N and **J12/NO 3** terminals.
   When using air-to-water heat pumps, **never** connect a **heat circulating pump** to this output.
10) The **return flow sensor** (R2) is either directly integrated in brine-to-water and water-to-water heat pumps or is included in the scope of supply as a separate component.
    The return flow sensor is integrated in air-to-water heat pumps for indoor installation and is connected to the heat pump manager via two single-core wires in the control line. Both single-core wires are connected to the terminals X3 (ground) and **J2/B2**.
    When implementing air-to-water heat pumps for outdoor installation, the return flow sensor must be connected to the common return flow of the heating system and the hot water system (e.g. immersion sleeve in compact manifold).
    The heat pump manager is also connected via the following terminals: X3 (ground) and J2/B2.
11) The **external sensor** (R1) is connected to the terminals X3 (ground) and **J2/B1**.
12) The **hot water sensor** (R3) is installed in the domestic hot water cylinder and is connected to the terminals X3 (ground) and **J2/B3**.
13) The heat pump and the heat pump manager are connected to each other (round plug) via coded **control lines** which must be ordered separately in the case of heat pumps installed outdoors. In the case of heat pumps with **hot gas defrosting** only, connect the single-core wire (No.8) to the terminal J4-Y1.

NOTE

If three-phase pumps are implemented, a power contactor can be controlled via the 230 V output signal of the heat pump manager.
Sensor cables can be extended to up to 30 m with 2 x 0.75 mm cables.





Legend

A1	The utility bridge (J5/ID3-EVS to X2) must be inserted if there is no utility blocking contactor (contact open = utility block).
A2	SPR bridge (J5/ID4-SPR to X2) must be removed, if the input is used (input open = heat pump off).
A3	Bridge (M11 fault). A floating NC contact can be used in place of A3 (e.g. protective motor switch).
A4	Bridge (M1 fault). A floating NC contact can be used in place of A4 (e.g. protective motor switch).
B2*	Low-pressure brine controller
B3*	Hot water thermostat
B4*	Swimming pool water thermostat
E9	Flange heater for hot water
E10*	Second heat generator (boiler or electric heating element)
F1	Control fuse N1 5x20 / 2.0 A slow-acting
F2	Load fuse for plug-in terminals J12 and J13 5 x 20 / 4.0 A Tr
F3	Load fuse for plug-in terminals J15 to J18 5 x 20 / 4.0 A Tr
H5*	Remote fault indicator lamp
J1	Control unit power supply connection (24 V AC / 50 Hz)
J2	Connection for hot water sensor, return flow sensor and external sensor
J3	Input for HP code and flow sensor using control line plug connector X8
J4	Output 0-10 V DC for controlling frequency converter, remote fault indicator, swimming pool circulating pump
J5	Connection for hot water thermostat, swimming pool thermostat and utility block function
J6	Connection for heating circuit 2 sensor and defrost end sensor
J7	Connection for “low-pressure brine” alarm message
J8	230 V AC inputs and outputs for control of the WP X11 control line plug connector
J9	Socket not used
J10	Socket for connecting the remote control (6-pole)
J11	Connection not used
J12 to J18	230V AC - Outputs for controlling the system components (pump, mixer, heating element, solenoid valves, boiler)
K9	230 V/ 24 V coupling relay
K11*	Electronic relay for remote fault indicator
K12*	Electronic relay for swimming pool water circulating pump
K20*	Contactor for 2nd heat generator
K21*	Contactor - electr. flange heater for hot water
K22*	Utility blocking contactor (EVS)
K23*	Auxiliary relay for SPR
M11*	Primary pump
M13*	Heat circulating pump
M15*	Heat circulating pump for heating circuit 2
M16*	Auxiliary circulating pump
M18*	Hot water circulating pump
M19*	Swimming pool water circulating pump
M21*	Mixer for main circuit or heating circuit 3
M22*	Mixer for heating circuit 2
N1	Control unit
N10	Remote control
N11	Relay module
R1	External wall sensor
R2	Return flow sensor
R3	Hot water sensor
R5	Sensor for heating circuit 2
R9	Flow sensor
R12	Defrost end sensor
R13	Sensor for heating circuit 3
T1	Safety transformer 230 / 24 V AC / 28 VA
X1	Terminal strip - supply connection, N and PE distribution board
X2	Distribution board terminal 24 V AC
X3	Distribution board terminal ground
X8	Control line plug connector (extra-low voltage)
X11	230 V AC control line plug connector

Abbreviations:

MA	Mixer “OPEN”
MZ	Mixer “CLOSED”
*	Components to be supplied from external sources

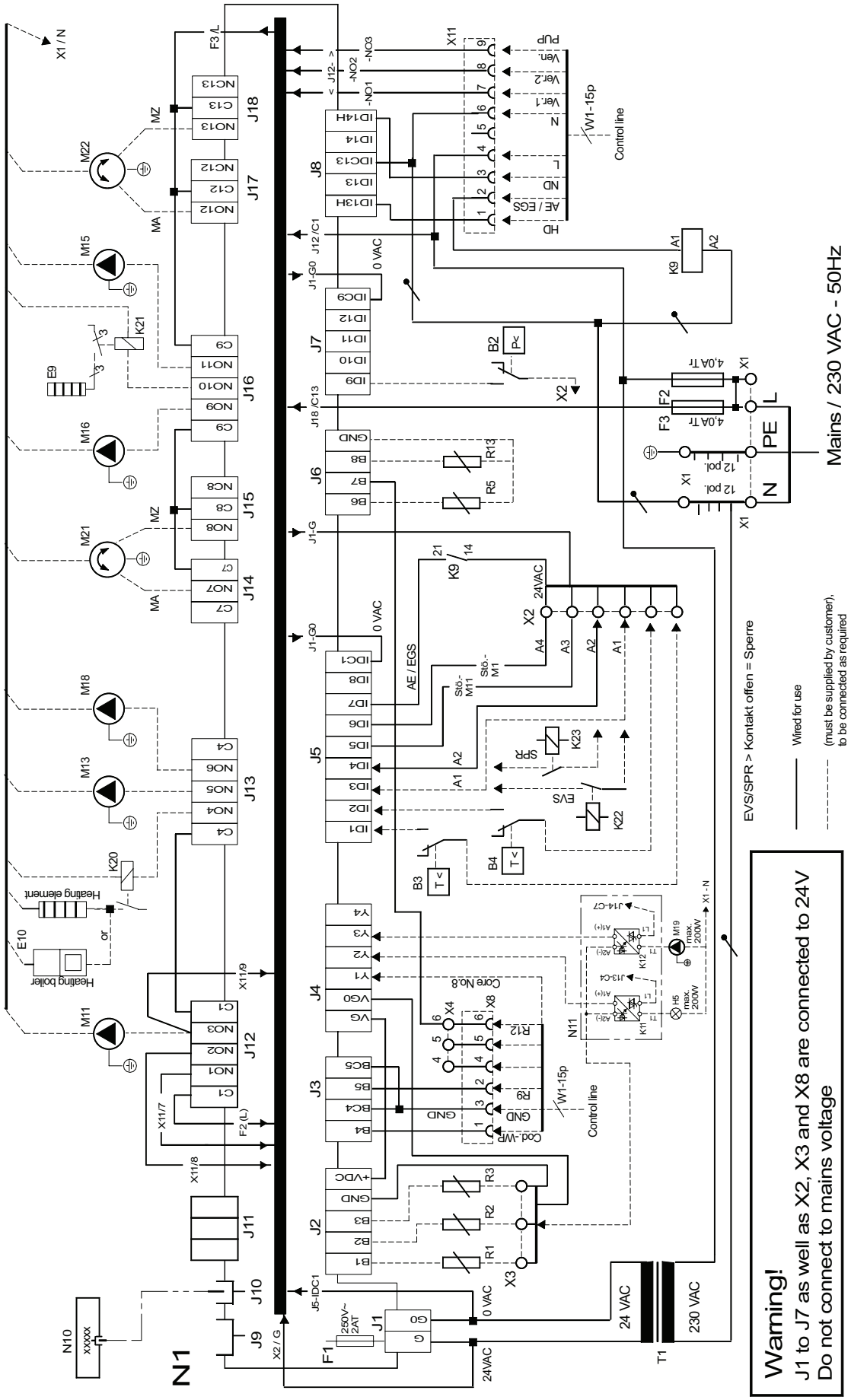


Table 10.1: Circuit diagram of the wall-mounted heat pump manager WPM 2006 plus (N1 heating controller)

10.3 Minimum Requirements for Domestic Hot Water Cylinder / Circulating Pump

Air-to-water heat pump for indoor installation

Heat Pump	Volume	Order designation	Pump
LIK 8TE / LI 9TE / LI 11TE / LI 20TE LIK 8ME / LI 11ME	300 l	WWSP 332 / PWS 332	UP 60
LI 24TE	400 l	WWSP 880	UP 60
LI 16TE / LI 28TE LIH 22TE	400 l	WWSP 880	UP 80
LIH 26TE	500 l	WWSP 900	UP 80

Air-to-water heat pump for outdoor installation

Heat Pump	Volume	Order designation	Pump
LA 11AS / LA 20AS LA 9PS / LA 11PS / LA 17PS LA 11MS	300 l	WWSP 332 / PWS 332	UP 60
LA 22PS	300 l	WWSP 332 / PWS 332	UP 80
LA 24AS	400 l	WWSP 880	UP 60
LA 16AS / LA 28AS LA 26PS / LA 22HS LA 16MS	400 l	WWSP 880	UP 80
LA 26HS	500 l	WWSP 900	UP 80

Brine-to-water heat pump for indoor installation

Heat Pump	Volume	Order designation	Pump
SIK 7TE / SIK 9TE / SIK 11TE SI 5TE / SI 7TE / SI 9TE / SI 11TE SIK 11ME / SI 5ME / SI 9ME / SI 11ME	300 l	WWSP 332 / PWS 332	UP 60
SIK 7TE / SIK 9TE / SIK 11TE / SIK 11ME	400 l	WWSP 442E	UP 60
SIK 14TE / SIK 16ME	400 l	WWSP 442E	UP 80
SI 14TE / SI 17TE	400 l	WWSP 880	UP 80
SI 21TE	500 l	WWSP 900	UP 80
SIH 20TE / SI 24TE	400l	WWSP 442E	UP 32-70
SIH 40TE / SI 37TE	500l	WWSP 900	UP 32-70
SI 50TE	500 l	WWSP 900	4.5 m^3/h
SI 75TE	2 x 400 l	2 x WWSP 880	6.5 m^3/h
SI 100TE	2 x 500	2 x WWSP 900	8.5 m^3/h
SI 130TE	3 x 500	3 x WWSP 900	11.5 m^3/h

Water-to-water heat pump for indoor installation

Heat Pump	Volume	Order designation	Pump
WI 9TE / WI 14TE	300 l	WWSP 332 / PWS 332	UP 60
WI 18TE / WI 22TE	400 l	WWSP 880	UP 80
WI 22TE	500 l	WWSP 900	UP 60
WI 27TE	500 l	WWSP 900	UP 80
WI 40CG	500 l	WWSP 900	UP 80
WI 90CG	2 x 500 l	2 x WWSP 900	8 m^3/h

(On the basis of the integration set-ups recommended in this manual and standard boundary conditions)

The table shows which domestic hot water circulating pumps and cylinders should be allocated to each type of heat pump in order to obtain a hot water temperature of approx. 45 °C in operation with **1 compressor** (maximum temperature of the heat source: Air: 25 °C, brine: 10 °C, water 10 °C).

The maximum hot water temperature which can be attained with heat-pump-only operation is dependent on:

- The heat output of the heat pump
- The heat exchanger surface area in the cylinder
- The volume flow in relation to the pressure drop and the capacity of the circulating pump.

NOTE

Higher temperatures can be reached by implementing larger heat exchanger areas in the cylinder, by increasing the volume flow or by targeted reheating using a heating element (see also *Chap. 6.1.3 on p. 149*).

10.4 Order Form for (Heating/Cooling) Heat Pump Start-Up

Commissioning Request Form: Heat Pump for Heating Purposes

Return by **fax: +49 (0) 92 21 / 70 9-5 65**

or by mail:

Glen Dimplex Deutschland GmbH
Kundendienst Systemtechnik
Am Goldenen Feld 18

95326 Kulmbach

Heat pump for heating purposes:

Type _____

Serial no.: _____ Date of manufacture: _____

Purchase date: _____ Delivery date: _____

Hot water preparation:

with heat pump for heating purposes: ❑ Yes ❑ No

Hot water tank
Make/type: _____

(No warranty for the proper functioning will be assumed if storage tanks of different makes are used or boilers which are not authorized for use with the specific heat pump type as this may result in heat pump operating problems.)

Heat exchanger surface: _____ m² Rated capacity: _____ Electric flange heating: _____ kW

A prerequisite for the acceptance of the extended warranty period of 36 months (from the date of commissioning) or a maximum of 38 months (from the date of delivery ex works) is that commissioning (at the client's expense) be carried out by the authorized Systemtechnik after-sales service, who will provide a commissioning report within an operating time (compressor runtime) of less than 150 hours.

The flat-rate charge for commissioning of currently € 340.00 (net) per heat pump covers the actual commissioning work and travel expenses. In addition, any costs incurred due to the fact that the system is not operational, or that system defects need to be corrected during commissioning, or any other waiting times or delays, will be charged as extras to the client by Systemtechnik after-sales service. No liability will be assumed as a result of commissioning for the correct planning, dimensioning and execution of the overall system.
The heating installer has to perform the adjustment of the heating system (overflow valve and hydraulic adjustment). This should not be carried out until the screed has dried out and is therefore not part of the commissioning activities.

During the commissioning, the client / system installer should be present. A commissioning report will be provided. Any defects that may be recorded in the commissioning report have to be corrected immediately. This is a precondition for the warranty. Within one month after the completion of the commissioning activities, the commissioning report has to be submitted to the above address who shall also confirm the extension of the warranty period.

Location of System

Name _____

Street _____

Postal code/Town _____

Telephone _____

Client/Recipient of Invoice

Company _____

Contact person _____

Street _____

Postal code/Town _____

Telephone _____

The client confirms that all required pre-commissioning activities have been carried out, checked and completed.

----------General checklist ----------

1. Does connection of the heat pump for heating purposes to the heating system comply with the planning documents; have shut-off elements been correctly adjusted? ..... ❑ YES ❑ NO
2. Has a minimum buffer volume of 10 % of the nominal flow rate of the heat pump been ensured by means of a buffer tank or other suitable measures? ..... ❑ YES ❑ NO
3. Has the entire heating system incl. all tanks and boilers been flushed prior to the connection of the heat pump?..... ❑ YES ❑ NO
4. Has the heating system been filled and pressure tested, are circulating pumps working properly? Have water flow rates been checked and are they in compliance with predefined requirements; have minimum flow rates been ensured? ..... ❑ YES ❑ NO
   Note: No heating circulating pumps with electronic differential pressure control must be used.
5. Have minimum clearances for servicing been maintained? ..... ❑ YES ❑ NO
6. Has the heat source system been completed, checked and been found to be okay; have strainers been cleaned? ..... ❑ YES ❑ NO
7. Has brine circuit been vented, a 24 – hour brine pump test run performed and the brine pressure adjusted to 2 – 2.5 bar?..... ❑ YES ❑ NO
8. Has the compatibility of the ground water with the water/water heat pump been verified (water analysis)? ..... ❑ YES ❑ NO
9. Have all electrical components been durably connected in accordance with the electrical connection diagram, has the clockwise phase sequence been complied with, are all sensors present and correctly mounted?..... ❑ YES ❑ NO
10. Has the motor protection of the primary pump (brine or well pump) been adjusted?..... ❑ YES ❑ NO
11. Has the heat pump manager been prepared in accordance with its mounting and operating instructions? ..... ❑ YES ❑ NO
12. Have the supply leads of the heating, hot water & supplementary circulating pumps, primary pump and the external, hot water and return sensors, all leading into the heat pump manager, been durably marked?..... ❑ YES ❑ NO

We herewith request the Systemtechnik after-sales service to carry out commissioning at our expense.

Date	Name	Signature (company stamp, if applicable)

One system for all types of heat sources

Dimplex heat pumps offer you three different future-proof heat sources, free of charge:
outside air, ground or ground water.

Together with the electric energy required to drive the heat pump, the stored solar energy generates the system's heating potential, which is transferred to a water-bearing heating system.

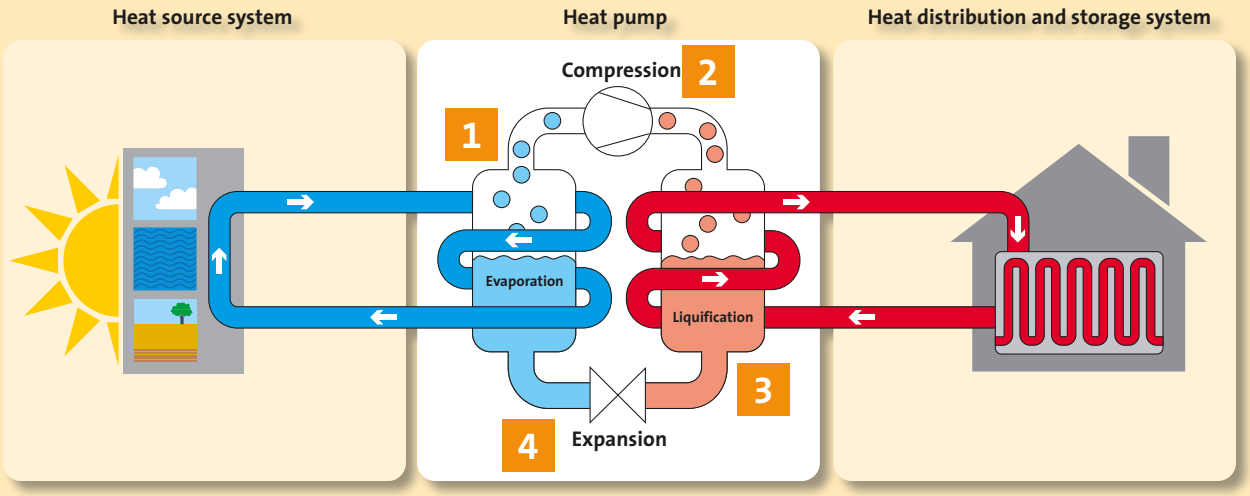
Heat pumps are among the most efficient heating and hot water systems available today. Since about 75% of their heating energy comes from the environment for free, they only require an additional 25% in the form of electricity to produce a 100% heat output.

Air-to-water heat pumps utilise the **outside air** as their energy source. Even at temperatures of up to -25°C, heat pumps can still extract heating energy from the outside air.

Brine-to-water heat pumps extract heat from the **ground**, year-round via ground heat collectors or borehole heat exchangers with a high heating capacity.

Water-to-water heat pumps extract the thermal energy from the **ground water**. If the supply is readily available and the quality is sufficient, ground water is the most efficient source of heat. However, it is also the most sensitive one.

HEAT PUMP OPERATING PRINCIPLE



Animations about heating and cooling with heat pumps are available for download at: **www.dimplex.de/en/downloads/animations**

A heat pump heating system consists of the heat source system, the heat pump itself and a heat distribution and storage system. Within the closed circuit of the heat pump, the refrigerant is responsible for transferring and transporting the heat.

1 The actual heat gain from the environment takes place in the heat pump's evaporator. This is where the liquid refrigerant comes into play, which evaporates even in sub-zero temperatures, thus storing the recovered energy.

2 The volume of the refrigerant, now in gaseous form, is then drawn in and reduced by the compressor. When the refrigerant is compressed, the pressure increases significantly, thus also increasing the temperature of the refrigerant.

3 Within the closed circuit, the hot refrigerant flows on to the liquefier – a heat exchanger in which the recovered environmental heat is transferred to the heating system.

4 Thanks to a cooling process, the refrigerant once again returns to liquid form. After the expansion valve has caused a reduction in pressure and temperature, the refrigerant can once again absorb thermal energy from the environment, and the cycle begins once again.

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